



Letter 160

May 2, 2000

Allen J. Fiksdal
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File No. 21530-20/SUMAS2

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MAY 02 2000

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EVALUATION COUNCIL

Dear Allen Fiksdal:

Thank you for the opportunity to comment on the Sumas Energy 2 Draft Environmental Impact Statement (EIS). The Lower Mainland Office of the Ministry has provided the enclosed comments on wastewater and aquifer impacts (Attachment 1). Should you have any questions on these, please contact Brian Clark, Manager, Environmental Assessment, at (604) 582-5217.

The ministry has also coordinated the development of comments on air quality issues (Attachment 2) on behalf of the Lower Fraser Valley (LFV) air quality agencies. If you have any questions on these, please contact Steve Sakiyama, Air Quality Analyst, at (250) 387-9942.

I trust that these comments will be helpful in the production of a final EIS, and will help clarify issues for EFSEC in their review of this project. I would like to thank you for your continued efforts to include our interests throughout the various stages of your process.

Yours truly,

Margaret Eckenfelder
Executive Director

Attachments

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Ministry of
Environment,
Lands and Parks.

Executive Director
Environment and Resource
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cc: P. Wieringa (Crown Corporate Secretariat)
T. Peace (Ministry of Health)
S. Sakiyama (Ministry of Environment, Lands and Parks)
B. Clark (Ministry of Environment, Lands and Parks)

LFV air quality agencies representatives:

B. Mills (Greater Vancouver Regional District)
G. Kingston (Fraser Valley Regional District)
K. Johnston (Environment Canada)
J. Randles (Northwest Air Pollution Authority)
P. Andzans (City of Abbotsford)
D. Pope (Ministry of Environment, Lands and Parks)
L. Bailey (Ministry of Environment, Lands and Parks)

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Lower Mainland Region, Ministry of Environment, Lands and Parks – DEIS Comments

Attachment 1

Comments on Section 3.2: Water Resources

The following are comments regarding potential impacts of the S2GF proposed development on groundwater resources (quantity and quality) within Canada.

Water for the proposed facility is to come from the City of Sumas' well fields. Extraction of approximately 850 US gallons per minute on a continuous basis is being proposed. This amount of extraction was calculated by the proponent's consultants to result in about one foot of drawdown in the natural groundwater table within a one-mile radius away from the Sumas well field (report figure 3.2-6). Projecting this zone of influence into Canada, this means that within a mile radius of the Sumas well field, wells in Canada could theoretically expect at least one foot less available drawdown in these wells. There are approximately 100 water well records on file (but not necessarily wells in use) within this one mile radius, including domestic wells and the City of Abbotsford's municipal wells. For wells that have a significant amount of available drawdown (i.e. the deeper wells >30m), one foot of drawdown is not a significant amount, depending on how deep the pump intake is. However, for shallower wells (<30 m depth), the reduction of available drawdown may result in some well owners requiring to lower their pump intakes (if possible) or deepening their wells. According to the City of Abbotsford, several of their production wells within the radius of influence have recently been taken out of operation. Estimates indicate that there is presently about 1200 US gallons per minute less extraction from these wells. This will effectively raise the water table locally and compensate to some degree the amount of drawdown interference effects from the proposed increase in Sumas well field pumping.

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In this area of the Abbotsford-Sumas Aquifer, the general direction of groundwater flow is south - southeastward from Canada into the U.S. Potential development or production impacts on the quality of groundwater on the U.S. side will not affect groundwater quality on the Canadian side of the aquifer.

Section 3.2, pg 3.2-27. There may be some risk of increased nitrate levels in well water discharging into the Johnson Creek (Sumas River) drainage if well water is needed to compensate for any significant reductions in base flows or spring flows to this drainage as a result of increased pumping from the Sumas well field. As the amount or degree of risk is unknown at this time, is it possible to provide some assessment of this risk?

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Lower Mainland Region, Ministry of Environment, Lands and Parks -- DEIS Comments

Attachment 1 (continued)

Wastewater Treatment

There are technical concerns with a significant additional contribution to the Abbotsford sewage collection system from Sumas via the Sumas 2 project. Present flows from the J.A.M.E.S. treatment plant are at and periodically over the maximum permitted levels. An environmental impact study of increased sewage flow to the Fraser River is being prepared. Recommended upgrades should be in place prior to FVRD accepting Sumas 2 waste water into the system.

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Lower Fraser Valley Air Quality Agency - DEIS Comments

Attachment 2

Comments on Section 3.1: Air Quality

General Comments

Section 3.1 (Air Quality) is a simplified version of the revised PSD application that was included in the Application for Site Certification Agreement document submitted to EFSEC in January. As with any simplification, there is a loss of detail. The following comments point out the areas where this detail is important from a BC perspective.

There is little information on the air quality impacts in Canada. For the criteria pollutants and the toxics, there are comparisons of the predicted maximums to various ambient guidelines/ objectives/ standards/ ASIL's (whether they are of Canadian or U.S. origin). However, air management in British Columbia is based on a more flexible approach than PSD, and thus comparisons to ambient objectives are not necessarily enough to determine the significance air quality impacts. In the case of deposition and visibility, the assessment has only focussed on the U.S. Class I areas even though deposition and visibility impacts will occur throughout the region.

The revised PSD application was more informative as it had additional tables and plots where the extent of the regional air quality impacts could be seen. In February, comments were sent to the proponent from the BC agencies on the revised PSD application and a detailed response document (dated April 18, 2000) is currently under review. It is enclosed for your information (Attachment A). The review of the response document (which represents a considerable technical effort) and its synthesis with the revised PSD application will not be completed until mid-May. The combination of both these documents is anticipated to provide a comprehensive and relevant information base for the assessment of air quality impacts in BC.

In summary, *on its own* the Draft Environmental Impact Statement does not provide the Canadian agencies with enough information required to assess the impacts of this proposed project on British Columbia air quality. The statement in Section 3.1.8 that concludes "no significant adverse air quality impacts would occur" is not supported by the information in Section 3.1

It is recognized that many of the following comments are a repeat of the comments made on the revised PSD application. It is possible that the April 18 response document addresses most if not all of them. However, since this document is still under review, and since the following comments are on the Draft EIS alone, they are included for completeness.

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Specific Comments

- Pg 3.1-2. Table 3.1-1. The Canadian/GVRD ambient air quality objectives should be listed here as they were in the revised PSD application. 5
- Pg 3.1-4. para. 2. The addition of SCR will reduce NOx emissions from 9 ppm to less than 4.5 ppm but will create emissions of NH3. In order to minimize ambient PM10, is the no SCR scenario a better alternative? 6
- Ammonia emissions are associated with SCR, although they have not been quantified (see Table 3.1-3). Please indicate the emitted amounts. 7
- Pg 3.1-4. Para 1. "Chapter 173-460 WAC requires that BACT also be used to control emissions of toxic air pollutants. In general the same technologies or operational parameters that reduce criteria pollutants ... also reduce toxic air pollutants. The use of combustion controls to optimize combustion also reduces both criteria pollutants (Table 3.1-1) and toxic air pollutants, such as lead, some heavy metals, and some organics." 8
- Although dispersion modelling shows that ambient impacts of toxic emissions are less than the ASIL's, there is no indication that the proposed control technology is BACT for air toxics.
- "the use of combustion controls to optimize combustion also reduces most criteria and toxic pollutants" . Is there a reference or rationale to support this statement as it applies to toxic pollutants? Does this statement still apply under oil firing conditions? 9
- During oil firing, will the sulphur gradually poison the catalysts and reduce the SCR's performance even during natural gas operation? 10
- The revised PSD application indicates 3 days per year of oil firing would be expected based on historical records. On what basis was the 15 days chosen? 11
- The use of oil will increase (in the case of SO2 up to 10 times) the emissions of both criteria pollutants and air toxics. Oil firing results in the highest ambient impacts of criteria pollutants, air toxics, depositions and visibility. What are the alternatives to oil firing? Other than reducing oil-firing periods, are there controls that could be applied to control emissions during oil firing? 12
- Pg 3.1-6, para 4 and 5. Typo "GRVD" should be "GVRD". 13
- Pg 3.1-6, para 5. The Abbotsford Airport station was terminated in 1994. The Abbotsford downtown station operated from 1992 to Sept 1998. Is the last 14

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sentence in the paragraph re: maximum hourly ozone applicable to the Abbotsford Downtown station? 14

Pg 3.1-6, last para. Is there any evidence to suggest that the measured PM10 was associated with woodsmoke, or fugitive dust, secondary aerosols, and or combustion sources (either solely responsible for the PM10 or in combination with each other)? If not then these sources should not be mentioned. 15

Pg 3.1-6, last sentence. As a qualifier on the Abbotsford data, Hi-vol PM10 monitoring began in 1992, while real-time hourly monitoring began in 1994. 16

Table 3.1-2. For 1996, the maximum 24-hour average PM10 was 73 ug/m3 and not the reported 62 ug/m3. The value of 73 ug/m3 is reported in the Appendix of the 1996 GVRD Annual Air Quality monitoring report. The relevant portion of the report is enclosed (see Attachment B). 17

Pg 3.1-7, last para. The BC MELP, 1997 document referred to does not indicate a source for high PM10 concentrations in Abbotsford. In the 1998 Lower Fraser Valley Ambient Air Quality Report there is a statement that indicates that high wind speeds are associated with elevated PM10. Attachment C includes the relevant portion of the report. However, note that an analysis of the winds during the 24-hour maximum PM10 (73 ug/m3) event in 1996 does not show such an association. A spreadsheet of this analysis is given in Attachment D. 18

Pg 3.1-13, last para. Abbotsford airport did not have a PM10 monitor. PM10 is currently measured at the new Abbotsford station and was measured at the previous Abbotsford downtown station. 19

The statement "high PM10 concentrations...associated with high wind conditions" is not correct if the "high PM10" refers to the maximum PM10 concentration during the 1996 – 1998 period. The identification of conditions under which the maximum occurs is important as there are conclusions made in this paragraph about the low probability of the predicted maximum PM10 occurring at the same time as a elevated PM10 event in that area of the valley. 20

Pg. 3.1-12. Table 3.1-6. Emissions of sulphuric acid mist conjure up images of dead vegetation and corroding materials. Please provide a description of the short-term and long-term impacts. Will they be confined to an area near the plant? 21

Table 3.1-7. What is the meaning of the first sentence of footnote b)? 22

Table 3.1-11. There is information missing in the Table. 23

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Pg. 3.1-14 Table 3.1-7 At the minimum, for predicted SO₂, NO₂, CO, and PM₁₀ the magnitude and location of the maximum value in BC should be identified. Maps of the impact areas for the region should be provided as were done in the revised PSD application. 24

Given the effort to develop an ambient PM_{2.5} standard under the Canada Wide Standards process, what can be concluded about the PM_{2.5} impacts of this proposed project? Can the PM₁₀ concentrations provided in this document be conservatively assumed to be all PM_{2.5}? What would be the maximum PM_{2.5} impacts in BC? 25

Pg. 3.1-15 Class II PSD increments: Although BC Environment does not have a PSD system in Canada, Canadian sources could still be among increment-consuming industrial sources. It is recognized that PSD is only concerned to those sources within the State. 26

For informational purposes, records indicate that there are 57 sources in BC with air permits within a 20 km radius of the proposed facility. From this list, there are 10 sources that have come into operation after the PSD baseline date of August 23, 1979 and have emission rates of SO₂ or PM₁₀ greater than 4 T/year (the 1 lb/hr criteria used in the analysis). The source emission rates and locations of these sources are shown in Attachment E. 27

Pg. 3.1-19/20 Tables 3.1-13/14. Provide the magnitudes and locations of the predicted maximums air toxics that occur in BC. 28

Pg 3.1-21 para 3. With reference to Table 3.1-15 there is a statement that the concentrations are higher near the Canadian border. This implies that they are even higher (as yet unspecified impacts) in BC. Please provide details on the impacts of SO₂ and NO_x concentrations in BC. 29

Pg. 3.1-24 Table 3.1-17. At a minimum, provide the magnitudes and locations of the predicted maximum depositions that occur in BC. A plot of the regional deposition should be provided as was given in the revised PSD application. 30

Measurements of annual deposition (Feller, 2000) for the past four years at the University of British Columbia research forest (approximately 49° 16' N, 122° 35' W) range between 19.0 and 32.1 kg/ha/yr for nitrogen and 12.8 and 23.8 for sulphur.

Table 3.1-18. There is no definition of b_{dry} and b_{SN} (hygroscopic and non hygroscopic?). 31

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Based on Table 3.1-18 and the predicted extinction values in Table 3.1-19, how were the percentages calculated in Table 3.1-20?

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Pg. 3.1-26. Table 3.1-19. At a minimum, provide the magnitude and locations of the predicted maximum extinction co-efficient that occurs in BC. A plot of the extinction over the complete modelling domain (as was included in the revised PSD application) should be provided.

Extinction coefficients are not useful in terms of communicating visibility impacts to the public. Specifically, will there be a reduction of visible range, an increase in visibility episodes, a change in haze colour? In response to comments made on the revised PSD application regarding visibility, the proponent has generated more information which will allow a better assessment of the visibility impacts (see Attachment A).

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Pg. 3.1-29 Greenhouse Gases. Some of the following comments are based on the submission by Dames and Moore document (Greenhouse Gas Offset Strategic Plan).

- The GHG emissions calculations did not appear to include N₂O, which is an emission by-product of SCR.
- Although Sumas2 suggests that they could satisfy BC Hydro's power purchase criteria, this assumes that BC Hydro will be purchasing power from Sumas 2. According to Pg. 1-2 para 1, BC Hydro has indicated no interest in purchasing the power.
- \$100,000 per year for 10 years has been committed to support GHG research, offsets, or management projects. Provide details on how this money will be managed and what specific tasks/projects will be funded.

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Pg. 3.1-31 Mitigation Measures.

In previous correspondence with the Ministry of Environment, Lands and Parks, the proponents committed to fund an air quality monitoring station. As well, they have indicated a consideration of an emissions curtailment program. Both of these commitments should be included here. The letter, which includes these commitments, is included in Attachment F.

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Page 3.1-31 Section 3.1.8 Significant Unavoidable Adverse Impacts

As stated earlier, the DEIS does not contain enough information on the air quality impacts in Canada to justify the statement "no significant adverse air quality impacts would occur". The revised PSD application was much better in this respect.

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References

Feller, M.C., 2000: Temporal trends in Precipitation and Streamwater Chemistry at the University of British Columbia Research Forest Near Maple Ridge, Draft Unpublished Interim Report, Environment Canada.

SUMAS ENERGY 2, INC.

335 Parkplace • Suite 110 • Kirkland, Washington 98033 • PHONE: (425) 889-1000 • FAX (425) 803-6902

April 18, 2000

Attachment A

Mr. Hu Wallis
Manager, Air Quality Assessment
Ministry of the Environment, Lands and Parks
P.O. Box 9341, Stn Provincial Government
Victoria BC V8W 9M1

Subject: Sumas Energy 2 Generating Facility (S2GF)

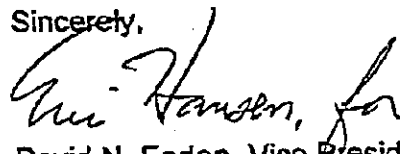
Dear Mr. Wallis:

Thank you for your letter of February 23, 2000 commenting on *Section 6.1 Sumas Energy 2 PSD Permit*. The Ministry's letter provided comments on our responses to your December 14, 1999 letter, and requested further information concerning potential air quality impacts from the Sumas Energy 2 Generating Facility (S2GF).

Our air quality consultants at MFG have prepared a response to your concerns. Per the Ministry's request, MFG conducted further CALPUFF simulations to assess PM10 concentrations and potential visibility impacts in the Lower Fraser Valley. The results of their assessment and responses to your comments are contained in the attachment to this letter. The attachment is divided into three sections: 1) further discussion related to our January 7, 2000 letter, 2) responses to your comments on the *Section 6.1 Sumas Energy 2 PSD Permit*, and 3) modeling focusing on the Lower Fraser Valley per your request for additional information.

I'd like to reiterate our interest in working with the Ministry and Lower Fraser Valley Air Quality Coordinating Committee in successfully resolving the issues you have addressed. Thank you once again for your continued interest and technical support in our project. We look forward to an opportunity to meet with you to discuss our findings.

Sincerely,


David N. Eaden, Vice President
Engineering & Construction
Sumas Energy 2, Inc.

DNE:bb

cc: E. Hansen, MFG K. Chaney, D&M K. McGaffey, PC D. Jones, NESCO

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MFG Response to MELP Comments of February 23, 2000

Section 1.0 Further Discussion Concerning Ministry Letter of December 14, 1999

MELP provided SE2 with a consolidated list of concerns and comments from Canadian air quality regulatory staff in a letter from Hu Wallis dated December 14, 1999. With assistance from MFG, David Eaden of SE2 responded those comments and concerns in a letter dated January 7, 2000. In the latest letter from MELP (February 23, 2000), additional clarification was requested for some of the responses provided in SE2's January 7 letter. In Section 1, we provide MELP's original comments (from December 14, 2000), our initial responses (from January 7, 2000), MELP's follow-up comments (from February 23, 2000), and a response to these latest comments. Both the Ministry's original and additional comments are highlighted in italics.

Original Comment 1.

Condition of Airshed: The proposed facility will add pollutants into an airshed already experiencing episodes of elevated ozone and PM as well as poor visibility.

Original Response to Comment 1.

All combustion sources generate air pollutants, and we acknowledge that SE2 will incrementally increase regional emissions. As noted above, however, SE2 has reduced the scale of its project and has substantially decreased NOx emissions. Because NOx is a precursor to ozone formation, we believe we have also substantially reduced our potential effect on ozone episodes.

As you are aware, Environment Canada is currently reviewing the results of their regional photochemical modeling that includes emissions from SE2. While the results have not yet been fully assessed, it is our expectation (based on the small portion of regional emissions we represent) that SE2 will not have significant adverse effects on regional ozone problems.

Similarly, we acknowledge that primary and secondary emissions attributable to the SE2 will incrementally increase regional haze. However, our preferred use of natural gas in the proposed combined cycle generating facility is the most energy efficient and least-polluting means of producing electricity that is currently available for fossil fuel based plants. In the scheme of things, our contribution to regional haze is relatively small. Furthermore, merchant plants such as the SE2 have the potential to displace older, less efficient electrical generating stations and may ultimately reduce air emissions attributable to regional electric power generation.

Additional Comment Regarding Response to Question 1:

Although there are assurances that contributions to regional haze will be relatively small it would be useful to provide quantifiable estimates of visibility and PM10 impacts to the LFV.

MFG conducted additional CALPUFF modeling to respond to your request for further analysis focusing on the Lower Fraser Valley. The results of the assessment are summarized in Section 3 of this letter. The photochemical modeling mentioned in our original response has been completed by Environment Canada.¹ Environment Canada's study concludes SE2 precursor emissions would result in small increases in ozone episode intensity (1 to 4 ppb) and no increase in ozone episode duration.

Original Comment 3.

Compliance with BC Ambient Objectives: The air quality impacts associated with the project need to be assessed in relation to BC ambient air quality objectives for NO2, CO, SO2, PM10, and O3.

Original Response to Comment 3.

The air quality analysis in our EFSEC Application for Site Certification (Application) assessed the ambient air quality implications of the SE2. Our analysis estimated maximum short-term concentrations by conservatively summing predictions based on the worst meteorological events in five winters, oil-fired turbine emissions from SE2, and the highest background concentrations from Abbotsford during 1996 to 1998. Even with this approach, we found that total air pollutant concentrations would be less than the most stringent Canadian Air Quality Objectives for SO2, carbon monoxide (CO), and nitrogen dioxide (NO2).

Monitoring data collected in Abbotsford indicate the Greater Vancouver Regional District (GVRD) interim 24-hour objective for PM10 is exceeded from zero to four days per year. Higher PM10 observations at Abbotsford have historically been associated with high wind events and windblown dust from agricultural areas and exposed soils in the eastern portion of the Lower Fraser Valley. Although such events can occur during the winter, those meteorological conditions are different than the conditions producing the highest SE2 concentrations. Maximum potential concentrations from SE2 occur while burning oil with light winds and stable conditions. Consequently, MFG believes it is

¹ Di Cenzo, C. and J. Potter, 2000. *A Numerical Simulation of Impacts on Ambient Ground-level Ozone Concentrations from the Proposed Sumas Energy 2, Inc Power Generation Facility*. Environment Canada, Vancouver, BC, Report 2000-001, January 31, 2000.

unlikely that the SE2 will contribute to or cause PM10 concentrations above the interim GVRD 24-hour Maximum Acceptable Objective.

Additional Comment Regarding Response to Question 3.

Do the PM10 estimates as determined from the modeling and used here in this response include secondary formation as well?

The ISCST3 modeling discussed in our original response does not contain the contributions of secondary aerosols potentially formed from SE2 precursor emissions to PM10 concentrations. Secondary aerosols are included in the background measurements at Abbotsford, but not in the predictions. However, the incremental increase in total PM10 concentrations expected from the SE2 including secondary aerosols is assessed in Section 3 of this letter.

Original Comment 4.

Cooling Tower Emissions: Water vapor (and associated nitrates) emissions on plume chemistry and the formation of nitrate aerosols should be included in assessing local and regional PM and visibility impacts.

Original Response to Comment 4.

The proposed SE2 configuration includes a wet/dry cooling system based on an air-cooled condenser and a cooling tower. The cooling tower would supplement the air-cooled condenser, providing up to 46 % of the thermal duty during warmer months. A small portion of the nitrate contained in the local water supply would be emitted from the cooling tower as cooling tower drift. Our cooling tower design calls for a maximum circulation rate of 51,250 gallons per minute with a drift loss rate of 0.0005 %. At this rate, the maximum nitrate emission rate would be about 0.002 lb/hr based on a nitrate concentration of 17 mg/l in the water supply. We believe your technical staff will affirm that these emissions are negligible.

Additional Comment Regarding Response to Question 4.

The response only covers part of the question. Plume chemistry (in particular the formation of some aerosol species) is highly dependant on relative humidity. Is there a possibility that the turbine plumes can be mixed with the cooling tower plume, thus causing local elevations of RH and enhancing aerosol formation? Is this an important feature that should be included in the analysis?

MFG does not believe secondary aerosol formation would be significantly affected by the proximity of the cooling tower for the following reasons:

- The turbine plumes are released at a higher point and are more buoyant than the cooling tower plumes. Thus, mixing between the cooling and turbine plumes is not expected until some distance from the plant.
- Any enhanced relative humidity in the plume would primarily affect the SO₂/SO₄ chemistry. Such effects, if any, would only occur when SE2 is oil-fired. Although SE2 contains provisions for oil-firing, historically periods of high demand for natural gas during winter are very rare.
- Initial elevated relative humidity in the plume may also affect the formation of particle nitrate from total nitrate and available ammonia. However, the plume nitrate chemistry is not irreversible and the gas/particle partitioning of nitrate would respond to equilibrium conditions. As ambient air is entrained in the plume, the nitrate chemistry would be more affected by ambient conditions than by the initial conditions within the plume.

Original Comment 5.

Ammonia Emissions: The use of SCR control technology with ammonia injection will result in direct ammonia impacts as well as ammonia contributions to secondary PM formation. It is important to consider these impacts given that ammonia is a major concern in the eastern LFV (due to agricultural activities) and current understanding of their involvement in photochemical processes.

Original Response to Comment 5.

Ammonia slip will be less than 10 ppmvd (15% O₂) for all operating scenarios. Based on this proposed permit limit, an assumed operating scenario of 350 days of gas firing (with duct burners), and 15 days of oil firing, MFG has estimated annual ammonia emissions of 276 U.S. TPY from our facility. The modeling analysis conducted for our plant indicates these emissions would result in maximum 24-hour and annual ammonia concentrations of 6 µg/m³ and 0.6 µg/m³, respectively. The maximum 24-hour predicted ammonia concentration is much less than the 100 µg/m³ screening criterion Washington applies to protect public health.

In 1996, Environment Canada conducted a monitoring program in which ammonia concentrations were measured at Abbotsford. The measured annual ammonia concentration was 16.4 µg/m³ during this period. The maximum predicted worst-case annual concentration attributable to SE2 is 0.6 µg/m³ or about 4% of the monitored background value. This indicates to us that our

ammonia emissions would not significantly contribute to annual ammonia concentrations in the Lower Fraser Valley.

Environment Canada also collected data on other airborne nitrogen compounds during 1996, and estimated the annual nitrogen deposition flux in Abbotsford to be 8.6 kg/ha/yr. As you are aware, we have conducted an extensive regional modeling analysis using the CALMET/CALPUFF modeling system. That analysis estimated the maximum annual nitrogen deposition flux attributable to our facility to be 0.05 kg/ha/yr - a small fraction of existing nitrogen deposition in the Lower Fraser Valley.

Existing ammonia concentrations in the Lower Fraser Valley contribute to secondary aerosol formation under certain meteorological conditions. Due to the large background concentrations of ammonia, MFG believes aerosol formation is not limited by available ammonia in the Lower Fraser Valley and the small additional amount of ammonia emitted from the SE2 should not promote further aerosol formation. The CALPUFF modeling conducted by MFG indicates aerosol formation is not a strong function of ammonia once the ammonia concentration reaches the level of existing concentrations at Abbotsford. Under these conditions, secondary aerosol formation is a stronger function of sulfate concentration, the nitrogen chemistry, and relative humidity.

Additional Comment Regarding Response to Question 5.

The response answers part of the question. Since ammonia is emitted from the stack along with the other constituents, it is available for immediate reaction to form nitrates and sulphates. Do the models account for the in-plume reactions to form secondary aerosols? Does it matter?

The last paragraph in this response is not clear. Under what meteorological conditions do the existing ammonia concentrations contribute? Why is aerosol formation not limited by available ammonia in the LFV? Is statement "aerosol formation is not a strong function of ammonia once the ammonia concentration reaches the level of existing concentrations at Abbotsford" based on the CALPUFF first order treatment of aerosol chemistry? Independent of the CALPUFF treatment, are the assumptions applied here conservative in terms of sulphate/nitrate formation?

CALPUFF does simulate sulfate/nitrate chemistry using a simple reaction mechanism that specifically tracks plume concentrations of sulfur dioxide (SO₂), sulfate (SO₄), oxides of nitrogen (NO_x), nitric acid (HNO₃), and nitrate (NO₃). The algorithm also depends on background concentrations of ammonia (NH₃), ozone (O₃), and water vapor (humidity), where O₃ and humidity are allowed to vary spatially and temporally.

CALPUFF does not explicitly simulate sources of NH_3 emissions. However, the sensitivity of the CALPUFF predictions to NH_3 can be examined by varying the NH_3 background concentration. MFG reran the CALPUFF model for both the Summer Duct-fired and Winter Oil-fired cases and compared the results for two different NH_3 background assumptions. In order to examine the extreme situation, MFG performed CALPUFF simulations with a background NH_3 concentration of 10 ppm (initial in-plume concentration due to ammonia slip) and compared the results to the simulations contained in the Section 6.1 PSD Permit where 17 ppb was used.

The results of the ammonia sensitivity tests indicate maximum nitrate and sulfate concentrations from SE2 would not change during the winter season even when the background ammonia concentration is increased to 10 ppm. During the winter, the background concentration of 17 ppb assumed in the PSD Permit is sufficient to ensure conversion to particle nitrate and the plume chemistry is not ammonia limited.

The CALPUFF simulations for the Summer Duct-fired case were slightly influenced by an increased background NH_3 concentration from 17 ppb to 10 ppm. MFG results indicate maximum 24-hour nitrate concentrations increased by 0.0 to $0.09 \mu\text{g}/\text{m}^3$ depending on the receptor location. MFG doesn't believe these increases are significant or alter the conclusions presented in the Section 6.1 PSD Permit. The CALPUFF sensitivity tests suggest the results of the SE2 simulations are not significantly affected by a higher background NH_3 concentration.

MFG also examined whether the ammonia emitted by SE2 would increase existing nitrate levels by allowing further conversion of ambient levels of nitric acid to particle nitrate. In order to further examine the role of NH_3 in the formation of particle nitrate, MFG extracted the chemistry modules from CALPUFF and examined different equilibrium concentrations.

Table 1 shows the gas-to-particle partitioning of NO_3 for four different meteorological conditions as a function of available NH_3 . As an example in the interpretation of Table 1, at equilibrium for the Winter High Humidity case, 4.88 ppb out of 5 ppb total nitrate would be in particle form if the ambient NH_3 concentration were 5 ppb. The amount of particle NO_3 formed is a function of ambient temperature, relative humidity, available NH_3 , and total NO_3 (HNO_3 and particle NO_3). For given total NO_3 , NH_3 , water vapor concentrations, higher particle NO_3 concentrations are expected at night or during the winter due to lower temperatures and higher relative humidity.

Table 1. Particle Nitrate (ppb) as a Function of Total Nitrate and Available Ammonia for Different Equilibrium Conditions

Total NO3 (ppb)	Winter High Humidity Conditions (RH=85%, T=273K)						
	Available NH3						
	1 ppb	2 ppb	5 ppb	10 ppb	20 ppb	50 ppb	100 ppb
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00
2.00	1.00	1.92	2.00	2.00	2.00	2.00	2.00
5.00	1.00	2.00	4.88	5.00	5.00	5.00	5.00
10.00	1.00	2.00	5.00	9.83	10.00	10.00	10.00
20.00	1.00	2.00	5.00	10.00	19.76	20.00	20.00
50.00	1.00	2.00	5.00	10.00	20.00	49.61	50.00
Total NO3 (ppb)	Summer Moderate Humidity Conditions (RH=50%, T=293K)						
	Available NH3						
	1 ppb	2 ppb	5 ppb	10 ppb	20 ppb	50 ppb	100 ppb
0.05	0.01	0.01	0.02	0.03	0.04	0.04	0.05
0.10	0.01	0.02	0.04	0.05	0.07	0.09	0.09
0.20	0.02	0.04	0.08	0.11	0.14	0.17	0.19
0.50	0.05	0.10	0.19	0.27	0.35	0.43	0.46
1.00	0.10	0.18	0.37	0.54	0.71	0.86	0.93
2.00	0.18	0.34	0.70	1.05	1.40	1.72	1.85
5.00	0.37	0.70	1.52	2.43	3.38	4.26	4.61
10.00	0.54	1.06	2.43	4.20	6.31	8.39	9.19
20.00	0.71	1.40	3.38	6.31	10.73	16.17	18.22
50.00	0.86	1.72	4.26	8.39	16.17	33.60	43.77
Total NO3 (ppb)	Winter Moderate Humidity Conditions (RH=50%, T=273K)						
	Available NH3						
	1 ppb	2 ppb	5 ppb	10 ppb	20 ppb	50 ppb	100 ppb
0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
0.20	0.19	0.20	0.20	0.20	0.20	0.20	0.20
0.50	0.47	0.49	0.50	0.50	0.50	0.50	0.50
1.00	0.84	0.97	0.99	1.00	1.00	1.00	1.00
2.00	0.97	1.77	1.98	1.99	2.00	2.00	2.00
5.00	0.99	1.98	4.63	4.97	4.99	5.00	5.00
10.00	1.00	1.99	4.97	9.48	9.97	9.99	10.00
20.00	1.00	2.00	4.99	9.97	19.25	19.98	19.99
50.00	1.00	2.00	5.00	9.99	19.98	48.81	49.97
Total NO3 (ppb)	Summer High Humidity Conditions (RH=95%, T=293K)						
	Available NH3						
	1 ppb	2 ppb	5 ppb	10 ppb	20 ppb	50 ppb	100 ppb
0.05	0.04	0.04	0.05	0.05	0.05	0.05	0.05
0.10	0.07	0.08	0.09	0.10	0.10	0.10	0.10
0.20	0.14	0.16	0.18	0.19	0.20	0.20	0.20
0.50	0.32	0.40	0.46	0.48	0.49	0.50	0.50
1.00	0.54	0.76	0.91	0.96	0.98	0.99	1.00
2.00	0.76	1.28	1.78	1.91	1.95	1.98	1.99
5.00	0.91	1.78	3.77	4.65	4.87	4.96	4.98
10.00	0.96	1.91	4.65	8.19	9.63	9.90	9.96
20.00	0.98	1.95	4.87	9.63	17.36	19.74	19.90
50.00	0.99	1.98	4.96	9.90	19.74	45.72	49.61

testeq.xls, Sheet1

4/18/00, 2:31 PM

Environment Canada measured NH₃ and NO₃ concentrations in Abbotsford weekly during 1996.² In their study, weekly NH₃ concentrations ranged from 3 to 58 ppb with a median annual concentration of 28 ppb, a median winter concentration of 18 ppb and a median summer concentration of 33 ppb. For the same period, the highest weekly average particle NO₃ concentration was 4.9 µg/m³ (2 ppb). Examination of Table 1 suggests formation of particle nitrate in Abbotsford must be limited by available HNO₃ since ambient NH₃ concentrations are high enough to allow a much higher concentration of particle nitrate than has been observed.

For example in the Winter High Humidity case in Table 1, a NH₃ concentration of 20 ppb and a total NO₃ (HNO₃ and particle NO₃) of 2 ppb results in a particle NO₃ concentration of 2 ppb at equilibrium. For these conditions, formation of nitrate is limited by the available total nitric acid formed through conversion from NO_x. That is increasing the NH₃ has no affect on the amount of nitrate formed. For the same 20 ppb NH₃ and 2 ppb total NO₃ concentrations, equilibrium results in 1.4 ppb of particle NO₃ for the Summer Moderate Humidity case. For these conditions the formation of particle nitrate is only a weak function of the NH₃ concentration.

In summary based on the data collected by Environment Canada in Abbotsford, existing high NH₃ concentrations in the area promote the formation of particle NO₃. The formation of nitrate appears to be limited by the transformation of NO_x to HNO₃, not by existing NH₃ concentrations. Existing concentrations of NH₃ are high enough that equilibrium conditions would not be influenced by the additional small increases in NH₃ concentrations from SE2.

Original Comment 9.

Visibility: Ambient PM increase due to this source (from both the stacks and cooling towers) will degrade visibility in the region. The potential impact on visibility in areas of BC should be considered.

Original Response to Comment 9.

Visible plumes from the cooling tower will be short and will not obscure visual resources in the Lower Fraser Valley. During daytime hours when the visibility is not obscured by local weather, average condensed plume lengths would be less than 50 m. It is highly unlikely that a visible cooling tower plume would cross the border into Canada.

² Belzer, W, Evans, C, and A. Poon, 1997. *Atmospheric Nitrogen Compounds in the Lower Fraser Valley*. Environment Canada, Vancouver, BC, Report DOE FRAP 1997-23, November, 1997.

The effects on regional haze due to PM10 directly emitted by the SE2, and secondary aerosols formed during transport, were assessed using the CALPUFF modeling system. The regional haze modeling analysis focused on potential visibility impacts in wilderness areas and national parks located in Washington State. Model-predicted extinction coefficients were compared to background extinction coefficients calculated from aerosol data on days with good visibility. The techniques in this analysis assume concentrations at specific receptors are representative of visual path-lengths that might be 100 km in length. The predictions from the CALPUFF modeling analysis suggest the SE2 will not significantly degrade visibility in these areas.

The CALPUFF model region includes the Lower Fraser Valley. Predictions of sulfate, nitrate, and PM10 were also obtained for receptors in British Columbia. The higher aerosol concentrations are predicted on Sumas Mountain, with much lower concentrations at lower elevations. In these instances the aerosol plume from the SE2 is comprised primarily of PM10 directly emitted and a small amount of nitrate formed during transport. The aerosol plume is also predicted to contain sulfate aerosols when the SE2 is fired by oil. The maximum predicted nitrate and sulfate concentrations are much less than observed in Abbotsford by Environment Canada during their 1996 study. The predicted change in local extinction coefficients caused by aerosols from the SE2 in the CALPUFF analysis suggests some reduction in local visibility may be possible depending on the geometry between the observer and the visual target, whether the SE2 is oil-fired, and background visual conditions.

Because there are so many variables in an assessment of visibility, it is difficult or impossible to fully characterize the impact of a single source. Our effect on visibility is likely to be proportional to our emissions compared with regional emissions.

Addition Comment Regarding Response to Question 9.

What are the maximum condensed plume lengths?

The maximum predicted condensed plume length approaches 10 km in the model simulations during periods when the relative humidity is near 100 percent. It is uncertain whether such condensed plumes would be visible. During daytime hours in the absence of weather obscuring phenomena median condensed plume lengths are 50 m. For these same conditions, the model simulations predict condensed plumes would be longer than 1 km for 166 hours per year. Full details of the cooling tower modeling are presented in Section 3.2.3 and Appendix B-4 of the Application for Site Certification.

"The techniques in this analysis assume concentrations at specific receptors are representative of visual path-lengths that might be 100 km in

length." The meaning of this is not clear. Are these for Canadian receptor areas?

For sources greater than 50 km from designated Class I areas, the United States federal land managers suggest that a 5 percent change to the 24-hour extinction coefficient would result in a "just perceptible" change to a scenic vista. In these areas, background visual ranges on the better days are greater than 200 km and the criterion assumes the change in extinction applies over a large portion of the visual path-length. This assumption is more appropriate for sources far upwind whose plumes over a 24-hour period may overlap a large portion of the Class I area.

SE2 plumes may not overlap the entire path-length of vistas in the Lower Fraser Valley due the relative short transport distances. The CALPUFF simulations suggest concentration gradients are often large and peak concentrations are not representative of concentrations over the entire Lower Fraser Valley airshed. MFG does not believe the criteria applied to examine impacts to Class I areas in the United States applies to the Lower Fraser Valley unless extinction coefficient are examined along the entire visual path-length.

It is recognized that describing visibility impacts is difficult. However, there needs to be some quantitative measure to support the assertion that SE2 will not significantly degrade visibility in Canada.

A quantitative assessment of SE2's potential influence on regional haze in the Lower Fraser Valley is presented in Section 3 of this letter.

The maximum PM10 estimates were produced by ISCST and CALPUFF. Do the values in the report include the primary PM10 and secondary PM?

The modeled PM10 concentrations in Section 6.1 Sumas Energy 2 PSD Permit do not include secondary aerosols. Please see the results of CALPUFF modelling in Section 3 of this letter.

Original Comment 11.

Continuous Emissions Monitoring (CEM): A CEM with real time data availability is installed at the Burrard Thermal power plant and other regionally significant sources. Continuous in-stack source monitoring should be considered.

Original Response to Comment 11.

SE2 proposes to install and operate continuous emission monitors to measure concentrations of oxides of nitrogen, carbon monoxide, and oxygen in each exhaust stack.

Additional Comment Regarding Response to Question 11.

The Ministry of Environment, Lands and Parks has a guideline document for emission criteria relating to gas fired turbines. The guidance document indicates that for SCR fitted systems, a CEM for NH3 should be considered.

There are no similar guidelines or requirements in the United States, nor are there any plans (at least at the federal level) for requiring ammonia CEMs. Because it is in our own best economic interest to minimize the amount of ammonia used to control NOx, we do not believe an ammonia CEM is warranted.

Original Comment 12.

Ambient Air Quality Monitoring: It would be prudent to ensure that there is adequate ambient air quality monitoring, as there is no monitoring information in the area of the proposed Sumas 2 facility. It is noted that such monitoring is a permit requirement funded by the proponent in a number of BC situations, including Burrard Thermal.

Original Response to Comment 12.

We will fund an air quality monitoring station since it should assist in efforts to improve regional air quality. Because our focus is on electrical power generation, we assume that operation of such a station would be the responsibility of staff from the GVRD, the Ministry, or the Northwest Air Pollution Authority. We would like to meet with Canadian and U.S. regulatory agency staff to discuss the scope of the monitoring program.

Addition Comment Regarding Response to Question 12.

Typically in British Columbia the permittee installs and operates the ambient monitoring program. Decisions on the details of the monitoring program need to be made in conjunction with the sponsoring agencies.

We have discussed operation of an air quality monitoring station with the Northwest Air Pollution Authority. Mr. James Randles, NWAPA's Air Pollution Control Officer, tells us that NWAPA would be willing to operate and maintain a station if SE2 provides the capital cost for installation.

Original Comment 13.

Curtailment Provisions: Noting that Burrard Thermal is subject to curtailment under conditions of poor air quality, it is suggested that curtailment provisions be considered for the plant.

Original Response to Comment 13.

Burrard Thermal is an older plant with higher emissions and a greater potential for contributing to ozone episodes. Nonetheless, using Burrard Thermal emissions as a reference, we are prepared to consider some reasonable curtailment arrangements provided that those arrangements will allow us to continue to honor our contractual commitments to supply power to our customers.

Additional Comment Regarding Response to Question 13.

Is there the possibility that the Sumas2 will operate situations when there is no contractual commitments to supply power?

SE2 will be a merchant plant. It will sell power into the western wholesale power market to various customers over various terms ranging in length from several years to one hour. SE2 intends to be a low-cost generator in this market and to run and sell power continuously, with periodic shutdowns for maintenance. There may be times when surplus power is available and market prices for power are so low that the plant would not run.

SE2 is prepared to discuss and consider some reasonable conditions under which it would curtail generation. Such curtailment conditions would have to be based on good air science and take into account the relatively low level of SE2's emissions compared to other sources, and the terms and conditions of SE2's power sales commitments.

Original Comment 14.

Greenhouse Gas Mitigation Plan: A greenhouse gas mitigation plan should be submitted as part of the EIS.

Original Response to Comment 14.

At present, neither Washington nor British Columbia has established laws or regulations that require a greenhouse gas (GHG) mitigation plan. Moreover, the SE2's high efficiency low emission design makes it a mitigation project itself to the extent that it displaces older, less efficient power plants. Nonetheless, we have examined the material you provided, including examples of GHG mitigation implemented by two Canadian industrial sources. We have also examined a program established by the State of Oregon.

In the spirit of cooperation, SE2 has prepared a Greenhouse Gas Mitigation Plan which will be submitted to EFSEC. In short, SE2 proposes to make a substantial investment in GHG research, in offset plans and/or management programs. SE2's strategic plan sets forth voluntary GHG mitigation goals, as well as measures that can be taken to achieve them. It identifies a menu of potential GHG offset and management opportunities.

Additional Comment Regarding Response to Question 14.

Any project under review in the British Columbia Environmental Assessment process, must submit a GHG mitigation plan. A guideline for the preparation of the plan is currently under development, and will be forwarded to Sumas2 Energy Inc once a draft is complete.

Thank you. We look forward to receiving it.

Section 2.0 Ministry Comments on Section 6.1 of the SE2 EFSEC Application

BACT.

This is a state-of-the-art, gas-fired, combined cycle generating plant that is designed to exceed all state/provincial emission & ambient guidelines. What are the averaging times associated with these emissions concentrations? The BC emission criteria for gas-fired turbines are based on averaging times of 1 hr.

Averaging times are determined at the time the air permit is issued. Typically, mass and concentration limits are based on 1-hour averaging times but sometimes they are averaged over a 24-hour time period. It should be noted that the emission limits proposed for S2GF are much lower than have been imposed on gas turbines operating in BC, so longer averaging times may be appropriate.

With respect to CEM monitoring each stack will be equipped with NOx, CO and O2 CEMS which is quite acceptable. The British Columbia Ministry of Environment, Lands and Parks gas fired turbine emission criteria requires an NH3 CEM where SCR is used (perhaps important to consider given the 276 T/year NH3 emission rate).

There are no similar guidelines or requirements in the United States, nor are there any plans (at least at the federal level) for requiring ammonia CEMs. Because it is in our own best economic interest to minimize the amount of ammonia used to control NOx, we do not believe an ammonia CEM is warranted.

Table 6.1-2. The PM10 emission is very high based on a comparison to other large gas fired turbines in B.C. Why? What does the PM10 emissions consist of? Are they all primary or is there an effective secondary component in this estimate as well?

The PM10 emission rate identified in our EFSEC application identifies both the filterable and condensable material (i.e., the front half and the back half catches of a Method 5 test). Most applications and permits in the U.S. and Canada seem to identify only the filterable (front half) portion of PM10. Considering only filterable particulate matter, S2GF emissions would be about 100 tons per year, or less than half the emission rate identified in our application.

Section 6.1.3.2.

Why does MFG think that the air quality data from Abbotsford, B.C. should provide conservative estimates of ambient concentrations at the SE2 site? Is this for all regulated air contaminants?

MFG used monitoring data from Abbotsford collected from 1996 through 1998 to represent background at the SE2 site. The Abbotsford site was located at 33660 South Fraser Way until September 1998. At this time the site was moved to the present location of 32995 Bevan Avenue. MFG visited both monitoring site locations. The former location was in downtown Abbotsford near to a well-travelled intersection. The present location is in a residential area. Due to the influence of motor vehicles, especially at the location on South Fraser Way, MFG believes these data are conservative for most pollutants of concern. MFG is unaware of another site that would be more representative and believes the Abbotsford site is the best data set available to characterize background concentrations at the SE2 site.

Background Air Quality

"PM10 concentrations associated with wood smoke, fugitive dust, secondary aerosols, and combustion sources...." Is there evidence to support this statement?

The statement refers to common sources of PM10 emissions and was not meant to imply that all the source categories contribute equally to PM10 concentrations observed in Abbotsford.

Table 6.1-9 typo for NO2 the footnote designator should be "(b)" instead of "(c)".

The "typo" was corrected in the final version of Section 6.1.

6.1.3.3 Dispersion Model Selection and Application

Figure 6.1-2 The windrose for Abbotsford airport shows a large percentage of calms (27%). Note that the maximum short-term concentrations (Table 6.1-10) occur under

stable, light-wind conditions. Could higher values occur if ISCST was able to handle calms? If the maximum PM10 concentrations occur under prolonged calms, the conditions which lead to the maximum PM10 concentrations will be missed (independent of how long the period of record is). Given that CALPUFF can handle calms, can it shed any light on whether the neglect of these hours is important in terms of predicting a maximum concentration?

MFG believes the five-year Abbotsford meteorological data set contains a sufficient number of light-wind, non-calm conditions to allow estimation of maximum short-term concentrations. ISCST may underestimate the buildup of pollutants that might occur during a multi-day stagnation episode. CALPUFF is a more appropriate tool to examine such events. MFG applied CALPUFF using a full year of meteorological data to assess PM10 concentrations, secondary aerosol formation, and visibility impacts in the Lower Fraser Valley. Section 3 of this letter identifies the results of that evaluation.

A receptor grid of 250 m and 1 km was used. As well two radial grids were also applied close to the proposed facility. Superimposing the 250 m grid over Figure 6.1-3 shows that the 250 grid only partially covers the large terrain features NNE and SE of the source. Given that the maximum concentrations occur during stable conditions in these elevated terrain areas, the plume at these downwind distances may not be adequately resolved to capture the maximum concentrations (i.e. its lateral dimension is less than 250 m). Was there any testing to see whether this grid size was adequate in these elevated terrain areas?

MFG performed sensitivity tests with ISCST3 by placing additional receptors surrounding the location of the maximum predictions in the elevated terrain southeast of the source. The maximum ISCST3 predictions did not significantly change from those reported in Section 6.1.

In order to better resolve concentrations in Canada, MFG performed additional ISCST3 simulations with a 250 m grid that covered all portions of Sumas Mountain within the modeling domain. Previously, the grid resolution was 1 km over most portions of Sumas Mountain. The results of these simulations are presented in Section 3 of this letter. Terrain elevations in BC were obtained by visual inspection of the 1:50,000 topographic map from the Canadian Center for Mapping. Due to the scale of this map, it is difficult to obtain a grid size any smaller than 250 m without inaccuracies.

Although it is clear that oil fired burning is estimated to be 15 days maximum, it is not clear how these days are incorporated into the ISCST. The 15 days of oil fired burning are limited to occur during the winter months. Which 15 days? Do the results change if a different 15 days within the winter month window are selected?

For short-term concentration estimates, MFG assumed oil firing of SE2 could occur for any day during a three-month period. The resulting maximum

predictions are conservative because the meteorology of the worst-case short-term event may not coincide with a day of oil firing.

Annual concentrations were calculated assuming 8,400 hours of gas-fired turbines supplemented with duct burners and 360 hours of oil firing. MFG assumed the 15-days of oil-fired emissions could occur anytime during the winter and spread these emissions evenly over the three-month period in the simulations. The annual concentration at each receptor was calculated by multiplying the ISCST3 predicted annual dilution ratio ($\mu\text{g}/\text{m}^3$ per g/s) for the gas-fired turbines by the annual emission rate (g/s) for this case, and adding this to the product of the ISCST3 predicted winter dilution ratio for the oil-fired turbines with the annual oil-fired emission rate.

The SIL's do not reflect effects levels, but rather they are administrative screening levels in the PSD system. Note regarding Table 6.1-11. Although for comparisons sake the NO2 Canadian air quality objective is included here, it is not strictly to be considered as an SIL (incremental). The Canadian air quality objectives are commonly used to assess total air quality.

There are no EPA SILs for short-term NO2 concentrations. MFG included the Canadian Air Quality Objectives so the reader would have at least some basis for comparison with the SE2 predictions. MFG did not intend to imply that the Canadian Air Quality Objectives should be used as SILs and did not apply these criteria in this way in the analysis.

Are the ISCST PM10 predictions an underestimate if they do not include a secondary aerosol component?

The ISCST3 PM10 predictions do not include secondary aerosol formation and as such underestimate the total PM10 concentrations. MFG included secondary aerosols in the CALPUFF predictions described in Section 3 below.

Figures 6.1-6,7,8,9,10,11. The isopleths indicate maximum concentrations occurring on Sumas Mountain (NNE of the proposed facility). What are the maximum values within the highest concentration isopleth? What is the maximum SO2 hourly impact in B.C.?

MFG conducted revised ISCST3 modeling for the Lower Fraser Valley with receptors located only in Canada. The results of the analysis are presented in Section 3 of this letter.

PSD Increment Analysis Class II Increments

Although this section involves information relevant to PSD permitting, the inclusion of U.S. only increment consuming sources may not give a true picture of the cumulative impacts from other contributing sources. If permitted sources within 20 km are used in

the modeling work, from a technical perspective would it not make sense to include those sources in British Columbia that may fall within this radius?

We are not aware of a situation where Canadian sources were included in a PSD increment assessment, but we agree that inclusion of new Canadian sources in the assessment does make technical sense. Does the Ministry know of any major SO₂ and PM₁₀ sources within 20 km of the SE2 site that became operational after August 23, 1979?

Class I Increments

In order to overcome the terrain treatment weaknesses in ISCST, the plume is assumed to follow the terrain at a constant height above local elevation. Concentrations from 0 – 250 m (vertically through the plume) above local terrain are determined. Is the technique an accepted EPA practice for this type of situation?

ISCST3 attenuates concentrations for receptors above plume height during stable conditions. For example, if the source elevation is 100 m above mean sea level and the final plume height is 200 m above the local ground level (at the site), then concentrations at receptor elevations above 300 m are reduced by ISCST3. For this example, ISCST3 concentrations would be zero for all receptor elevations above 700 m during stable conditions.

The plume attenuation assumptions in ISCST3 are more appropriate for nearby terrain features and could result in underestimation of impacts to Class I areas where terrain elevations may be much higher than at the site. In order to obtain conservative predictions, MFG assumed there would be terrain features within the Class I areas where plume impacts would be maximized.

Receptors were not treated as "flagpole" receptors. In these calculations, MFG used the regulatory defaults in ISCST3 for plume path adjustments and terrain heights were varied to obtain the maximum prediction.

Do the PM₁₀ concentrations reported in Table 6.1-17 include a secondary component?

The ISCST3 PM₁₀ predictions do not include secondary aerosol formation. MFG included secondary aerosols in the CALPUFF predictions described in Section 3 below.

Ambient Air Quality Standard Assessment.

Table 6.1-20. Does the PM₁₀ concentration reported in this table as well as in footnote (d) include a secondary component?

The ISCST3 PM10 predictions do not include secondary aerosol formation. MFG included secondary aerosols in the CALPUFF predictions described in Section 3 below.

Regarding footnote (d), does this max correspond to the high impact area on Sumas Mountain as shown on Figure 6.1-9? How does this relate to the magnitude and location of the CALPUFF predicted maximum for PM10? Given the better physics associated with CALPUFF, should not the CALPUFF predicted maximum values be used in the comparisons to the PM10 objectives?

The highest 24-hour PM10 concentrations in the Lower Fraser Valley as simulated by both ISCST3 and CALPUFF occur on Sumas Mountain. MFG agrees CALPUFF should provide more realistic simulations than ISCST3. The results of a CALPUFF modeling study assessing PM10 concentrations in the Lower Fraser Valley are described in Section 3.

Correction: Environment Canada (not GVRD) have conducted several regional photochemical modeling studies.

Comment noted, although MFG understands the GVRD contributed to the emission inventories used in these studies.

Now that the Environment Canada has completed the ground-level ozone impacts study, the paragraph describing this work can now be updated.

Yes, thank you. We intend to refer to Environment Canada's study when ozone concerns are raised.

ADDITIONAL IMPACT ASSESSMENT

Given that this is a PSD application, the work has focused on the U.S. Class 1 areas although the Calpuff model domain includes the LFV, there is a need for more interpretive work to understand the PM and visibility impacts in Canada.

To respond to the Ministry's request, MFG applied CALPUFF using a full year of meteorological data to assess PM10 concentrations, secondary aerosol formation, and visibility in the Lower Fraser Valley. The results of this analysis are described below in Section 3.

Calpuff does not include an explicit treatment of aqueous phase conversion of SO2 to sulphate, an important mechanism in this region. Would this mean that sulphate (and thus PM10 and bext) is underestimated as a result?

It would be useful if the Ministry could provide MFG with references where the aqueous phase conversion of SO2 to sulfate has been documented in the Lower Fraser Valley. Such studies might provide the means of estimating a conversion

rate that could be used for CALPUFF simulations. Note, CALPUFF does consider aqueous conversion, but the rate is limited to 3 percent per hour.

Except for the oil firing case, SO₂ emissions from SE2 are insignificant. Under certain meteorological circumstances when SE2 is oil-fired, sulfate concentrations, extinction coefficients, and total PM₁₀ concentrations may be underpredicted in the simulations because aqueous conversion is limited to 3 percent per hour by the model. Note, however, that fog and cloud water deposition are removal mechanisms for sulfate that are also not included in CALPUFF.

How was the MMS data used in CALMET? As an initial guess field with observations weighted as zero or as observations with a weighting field applied? Why was this approach taken?

The MMS data were used as an initialize guess field for the CALMET objective procedures. Wind observations were not used to construct the wind fields. The use of observations to nudge the MMS winds has the potential to improve forecasts in some situations, but this is usually accomplished with upper air data or is applied to retrospectively examine episodes of interest. University of Washington MMS model performance statistics suggest the model does reasonably well explaining the wind statistics for surface sites in the Pacific Northwest, but can miss-time the passage of frontal systems and other events. If local observations are used in these circumstances, CALMET will adjust the winds resulting in artificial local circulations surrounding each station. The decision to rely solely on the MMS winds was the consensus opinion expressed in conversations with Ecology staff, United States federal land managers, and University of Washington scientists.

The Abbotsford observed windrose has a low wind speed range of 0.1 – 1.5 m/s. This implies that calms are any wind less than 0.1 m/s. The starting threshold of the airport UA2 anemometer is around 1 m/s.

Comment noted. The low wind speed range used in the construction of the wind rose was not meant to correspond to the threshold of the anemometer. Wind speeds lower than 1 m/s are included throughout the Abbotsford data set. MFG treated these as valid observations.

The Abbotsford windrose as generated by CALMET indicates a much higher frequency of winds from the SW sector than the observed windrose and a much higher frequency of winds between 1.5 – 3 m/s. What are the implications of using the CALMET generated winds vs. using the Abbotsford wind observation data for the predictions around the local (Abbotsford area)? If this data were to be used in the ISCST simulations, it would seem that there would be even more transport of material into B.C. and higher maximum values than that reported in the ISCST modeling work.

MFG has not simulated the 1998/1999 meteorological periods of the CALPUFF simulations with ISCST3, nor has MFG tried to construct an ISCST3 data set using the CALMET predicted surface winds. Without performing these simulations, MFG does not want to speculate on the implications of using CALMET versus Abbotsford wind data in ISCST3 simulations.

Vegetation, Soils, and Aquatic Resources

How sensitive are the results to the assumed value of background O₃ (40 ppb?). What was the choice of 40 ppb based on? Is this conservative?

Ozone concentrations affect the daytime conversion rates of NO_x to HNO₃ and SO₂ to SO₄. A doubling of the ozone concentration results in a 270 percent increase in the conversion rate for NO_x to HNO₃ and a 160 percent increase in the SO₂ to SO₄ conversion rate. The CALPUFF simulations are only sensitive to the assumed 40 ppb background ozone concentration during the winter season in areas of the model domain where ozone monitoring is not conducted outside of the "ozone season". During periods of the year when ozone concentrations can be expected to be above 40 ppb, local observations were available within the entire model domain and MFG used these data directly in the simulations. In the Lower Fraser Valley, ozone data were available for all seasons and the CALPUFF simulations calculates conversion rates based on these local data.

MFG believes 40 ppb is a conservative assumption for portions of the model domain in Washington State outside of the "ozone season". For the stations where ozone data are available during the winter of 1998/1999, MFG calculated the average ozone concentration as 19 ppb.

Regarding ammonia concentrations, how is the in-plume ammonia (due to ammonia slip) accounted for in the CALPUFF transformation calculations or are the assumptions made in this analysis conservative with respect to ammonia availability and transformations.

Please refer to the above responses to these same questions under Comment 5 in Section 1 of this letter.

Figures 6.1-20,21,22,23 all show maximum depositions occurring in the Canadian side of the LFV. What are these maximums?

The maximum annual total nitrogen (Figure 6.1-20) and sulfur (Figure 6.1-21) deposition fluxes in Canada are 0.0506 kg/ha/yr and 0.0681 kg/ha/yr, respectively. Figure 6.1-22 and Figure 6.1-23 do not show deposition fluxes.

Regional Haze Assessment

Is it EPA practice to use a 24 hour average extinction co-efficient as a measure of regional haze? Does this neglect a short-term peak (<24 hr) where the extinction could

be much greater than the 24 hour predicted value? Would a daytime best average be higher than the 24 hour average values given here?

The 24-hour average extinction coefficient has been adopted by the EPA and United States federal land managers for regional haze assessments of impacts to Class I areas. Diurnal variations in the extinction coefficient can be expected to result in short-term peaks above the 24-hour average coefficient. MFG does not know whether a daytime average extinction coefficient would be higher than the 24-hour average coefficient. However, higher humidity at night might be expected to result in higher extinction coefficients than during the day.

Table 6.1-24. Are the PM10 emission rates reported here consistent with the values reported in Table 6.1 for the oil-fired scenario?

There is an error in Table 6.1-24. The elemental carbon (EC) fraction of the PM10 emission rate is 19.1 lb/hr (30 percent of 63.6 lb/hr) not 21.8 lb/hr. The speciation of PM10 actually occurs during the post-processing of the CALPUFF output files by the CALPOST program. The correct EC fraction was assigned during this procedure.

The maximum extinction coefficient plots of Figure 6.1-24 to 28 indicate the maximum values are in Canada. What are these maximums? Under what conditions do they occur?

The 24-hour extinction coefficient maximums for gas firing (with duct burners) in spring, summer, fall, and winter, and for winter oil-firing are presented in Figures 6.1-24 to 6.1-28 are 17.9, 47.7, 37.7, 31.0, and 95.7 (1/Mm), respectively. In the same order, these events occurred for the meteorology on May 16, 1998; July 22, 1998, September 12, 1998; January 4, 1999, and January 4, 1999. The extinction coefficients do not include background extinction and are based on the CALPUFF simulations with a 4 km sampling grid. More refined modeling for the Lower Fraser Valley is presented below in Section 3.

Table 6.1-26 is useful, however a plot of these values over the domain similar to the extinction coefficient plots of Figures 6.1-24 to 28 would be useful to assess the PM10 impacts over the LFV and beyond. As well it would be useful to indicate the CALPUFF predicted maximum PM10 values, and the conditions under which they occur.

In Section 3 of this letter, MFG applies CALPUFF using a full year of meteorological data to assess PM10 concentrations, secondary aerosol formation, and visibility in the Lower Fraser Valley.

Section 3.0 Additional Analysis Conducted at the Requests of the Ministry of the Environment, Lands, and Parks

In response to requests for further information from the Ministry, MFG conducted additional modeling analyses with the ISCST3 and CALPUFF models. These modeling simulations focused on potential impacts to the Lower Fraser Valley using more refined receptor grids. In addition, CALPUFF simulations were used to assess visibility for specific scenic vistas or Lines of Sight (LOS) provided by the Ministry for the Abbotsford and Chilliwack areas. The techniques applied and the results of these analyses are presented in the remainder of this section. The comments from the Ministry that initiated the additional analysis are shown in italics below.

APPENDIX - Suggested Information Useful for Canadian Regulators

As discussed during the February 3/2000 meeting between Environment Canada, the GVRD, MELP and MFG, it would be useful to have a document which draws out the salient points of the PSD application and presents them in a manner more meaningful to Canadian agencies.

Specific information which is requested to assess potential Canadian impacts from the Sumas 2 facility include the following:

Re: ISC Predictions

Additional information pertinent to BC is requested. In particular:

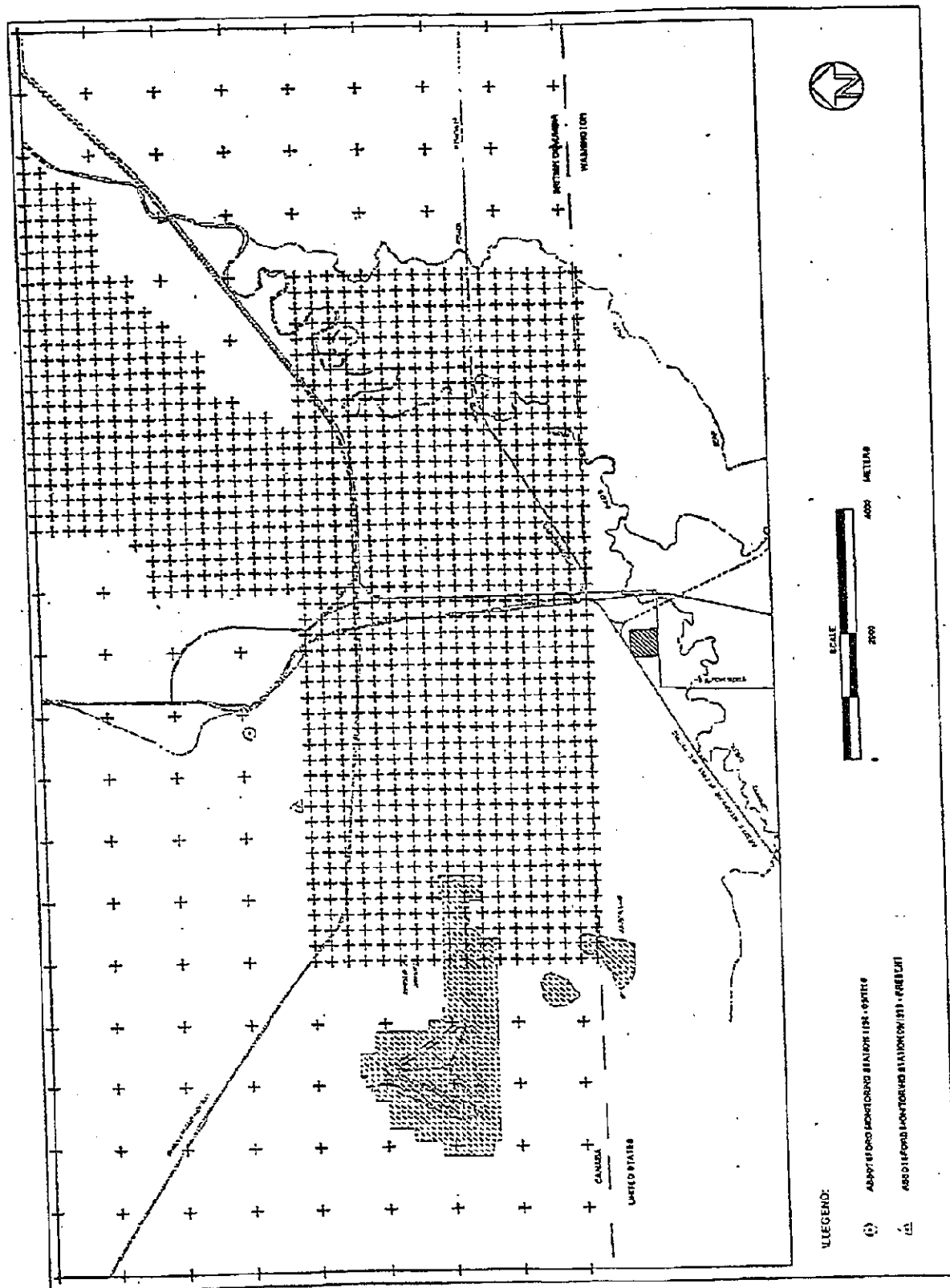
To Table 6.1-20, add the location of the maximum (direction and distance from the source, rather than UTM), the associated meteorological conditions, and their frequency of occurrence

Repeat Table 6.1-20 for the maximum impacts predicted in BC.

MFG conducted additional simulations with ISCST3 to refine predictions in British Columbia. Figure 1 displays the receptor grid that was employed in the model simulations. Most of these receptors were also used in the original ISCST3 analysis. Additional receptors were placed on Sumas Mountain on a 250 m grid to ensure the higher impacts for SE2 are captured in the modeling. Receptor elevations were visually extracted from a 1:50,000 scale topographic map.

With the exception of the receptor locations, MFG applied ISCST3 using the same options and data sets as are described in *Section 6.1 Sumas Energy 2 PSD Permit*. The maximum concentrations predicted by ISCST3 are shown in Table 2 based on the five-year Abbotsford meteorological data set and four operating scenarios. With the exception of the 1-hour predictions for the Partial Load case, the maximum concentrations from ISCST3 are lower in British Columbia than predicted for Washington State (See Figure 6.1-11 in Section 6.1). For the Partial Load case, the

Figure 1. Receptor Grid for ISCST3 Analysis in the Lower Fraser Valley



highest 1-hour predictions occur on the small hill just north of SE2 on the Canadian border.

The maximum concentrations from SE2 all occur for the oil-fired case. With the exception of the 1-hour averaging period, the maximum concentrations are located at the same receptor on Sumas Mountain. This receptor is located at the 180 m level, 6 km north-northeast of SE2. The maximum plume impacts at this receptor occur during persistent winds from the south-southwest, stable conditions, and winds generally less than 2 m/s through the averaging period. The maximum 1-hour concentration for the oil-fired case occurs on the hill 800 m north of SE2 during high winds (14 m/s) from the south. Each of these events occurred once in five years.

For comparison with Canadian Air Quality Objectives, MFG added the maximum concentrations from SE2 to background monitoring data from Abbotsford. Background concentrations for each averaging period and pollutant were calculated from the average of the maximum concentrations for each of the three years 1996 to 1998. These background data are the same as shown in Table 6.1-9 contained in *Section 6.1 Sumas Energy 2 PSD Permit*. As shown in Table 3, the sums of the maximum predictions plus the maximum background concentrations are less than the most stringent Canadian Air Quality Objectives, with the exception of the PM10 concentrations. Further discussion of PM10 concentrations continues below.

TABLE 2
MAXIMUM SHORT-TERM CRITERIA POLLUTANT PREDICTIONS

Pollutant	Averaging Time	Maximum SE2 Concentration ($\mu\text{g}/\text{m}^3$) in British Columbia			
		Gas-Fired Partial Load	Gas-Fired Base Load	Gas-Fired Base Load With Duct Firing	Oil-Fired Base Load
NO2 (a)	1 hour	14.7	16.7	21.6	50.5
	24 hour	2.56	3.21	4.06	9.22
	Annual(c)	0.436			
SO2	1 hour	0.78	0.93	1.31	57.4
	3 hour	0.46	0.60	0.83	35.2
	24 hour	0.14	0.18	0.25	10.5
	Annual(c)	0.062			
CO	1 hour	5.97	6.80	8.75	30.8
	8 hour	2.18	2.84	3.56	12.1
PM10(b)	24 hour	2.73	3.11	3.91	7.40
	Annual(c)	0.415			

(a) NO_x is conservatively assumed to be fully converted to NO₂.

(b) Does not include secondary aerosols.

(c) Annual concentrations based on 15 days oil firing and 350 days of gas firing with supplemental duct burners.

TABLE 3
COMPARISON WITH CANADIAN AIR QUALITY OBJECTIVES

Criteria Pollutant	Averaging Period (hours)	Maximum Concentrations ($\mu\text{g}/\text{m}^3$) In British Columbia			Most Stringent Canadian Objective ($\mu\text{g}/\text{m}^3$)
		SE2 (a)	Background(d)	Total	
SO ₂	1	57	37	94	450
	3	35	28	73	375
	24	11	9	20	150
	Annual	0.06	2	2	25
NO ₂ (b)	1	51	117	168	400
	24	9	62	71	200
	Annual	0.44	33	33	60
CO	1	31	7,760	7,791	14,300
	8	12	3,419	3,431	5,500
PM ₁₀ (c)	24	7	57	64	50
	Annual	0.42	16	16	30
<p>(a) Short-term maximum prediction of four operating scenarios and five years of meteorological data. Annual concentrations based on 15 days of oil firing and 350 days gas-fired with supplemental duct firing.</p> <p>(b) NO_x is assumed to be fully converted to NO₂.</p> <p>(c) Does not include secondary aerosols.</p> <p>(d) Average annual maximum concentration for each pollutant and averaging period observed at Abbotsford during 1996-1998. See Table 6.1-9 in Section 6.1 Sumas Energy 2 Application for Site Certification.</p>					

As alternatives to using the maximum observed concentration as baseline, calculate the maximum, 98th, 75th and 50th percentile PM₁₀ values for Abbotsford over a three-year period and present along side the maximum predicted incremental PM₁₀ impacts.

The maximum, 98th, 75th and 50th percentile PM₁₀ observed at Abbotsford during 1996 to 1998 concentrations are added to the maximum 24-hour SE2 PM₁₀ concentration (at a receptor on Sumas Mountain) in Table 4. When the joint probability of oil firing (no more than 4 percent of the year) and exceedances of the PM₁₀ objective (less than 2 percent of the time), it is clear that a PM₁₀ violation is very unlikely. When one considers that background PM₁₀ concentrations on Sumas Mountain are likely to be much lower than in Abbotsford, the potential for a violation attributable to S2GF approaches zero.

TABLE 4
MAXIMUM PM10 CONCENTRATIONS USING DIFFERENT BACKGROUND ASSUMPTIONS

Basis for Background	Abbotsford PM10 ($\mu\text{g}/\text{m}^3$) (a)	SE2 Maximum PM10 ($\mu\text{g}/\text{m}^3$) (b)	Total PM10 ($\mu\text{g}/\text{m}^3$)	GVRD 24-hour Interim Objective ($\mu\text{g}/\text{m}^3$)
Maximum	66.0	7.4	73.4	50
98 th percentile	36.1	7.4	43.5	50
75 th percentile	19.4	7.4	26.8	50
50 th percentile	13.8	7.4	21.2	50
(a) Calculated from Abbotsford monitoring data during 1996 to 1998.				
(b) 24-hour maximum predicted SE2 PM10 concentration for oil-fired case. Does not include secondary aerosols				

Provide annual percentiles (maximum, 98th, 75th and 50th) of the predicted 24-hour PM10 concentrations at the Abbotsford monitoring site.

MFG applied ISCST3 to predict 24-hour PM10 concentrations at the Abbotsford monitoring site. MFG conservatively assumed oil-fired emissions for each winter day and gas-fired turbines with duct burners for all other days. Based on 5 years of Abbotsford meteorological data, the maximum, 98th, 75th, and 50th 24-hour PM10 concentrations at the Abbotsford monitoring site are $1.4 \mu\text{g}/\text{m}^3$, $0.64 \mu\text{g}/\text{m}^3$, $0.033 \mu\text{g}/\text{m}^3$, $0.0 \mu\text{g}/\text{m}^3$, respectively.

Repeat Table 6.1-13 (toxic air pollutants) for the maximum impacts predicted in BC, and identify the location, magnitude, conditions and frequency of occurrence.

MFG prepared Table 5 and Table 6 to summarize the respective results of the 24-hour and annual toxic air pollutant analysis. The simulations were performed using the receptor grid shown in Figure 1. The location and meteorological conditions associated with maximum predictions are the same as for the criteria pollutants and were discussed previously.

TABLE 5
MAXIMUM SHORT-TERM TOXIC POLLUTANT PREDICTIONS

Pollutant	Maximum 24-hour Concentrations ($\mu\text{g}/\text{m}^3$) In British Columbia				24-hour Ecology ASIL ($\mu\text{g}/\text{m}^3$)
	Gas-Fired Partial Load	Gas-Fired Base Load	Gas-Fired With Duct Firing	Oil-Fired Base Load	
Acrolein	0.0020	0.0025	0.0033	Nd	0.02
Ammonia	3.15	3.97	5.23	3.89	100
Chromium	Nd	Nd	Nd	0.0014	1.7
Ethylbenzene	0.0060	0.0076	0.0099	Nd	1000
Lead	Nd	Nd	Nd	0.0022	0.5
Manganese	Nd	Nd	Nd	0.0891	0.4
Mercury	0.0001	0.0001	0.0002	0.0001	0.17
Naphthalene	0.0347	0.0441	0.0578	0.0064	170
Selenium	Nd	Nd	Nd	0.0048	0.67
Sulfuric Acid Mist	0.0128	0.0169	0.0232	2.17	3.3
Toluene	0.0323	0.0410	0.0536	Nd	400
Xylenes	0.0067	0.0085	0.0111	Nd	1500
Note: Nd refers to no data or stack test results less than the method detection limit.					

TABLE 6
MAXIMUM ANNUAL TOXIC AIR POLLUTANT CONCENTRATIONS

Pollutant	Maximum Annual Concentration ($\mu\text{g}/\text{m}^3$) In British Columbia (a)			Annual Ecology ASIL ($\mu\text{g}/\text{m}^3$)
	Gas-Fired With Duct Firing	Base Load Oil-Fired	Total	
Acetaldehyde	3.28E-03	2.36E-05	3.30E-03	4.50E-01
Arsenic	2.01E-06	6.03E-06	8.04E-06	2.30E-04
Benzene	5.73E-03	4.17E-05	5.77E-03	1.20E-01
Beryllium	Nd	2.52E-07	2.52E-07	4.20E-04
Cadmium	Nd	2.47E-06	2.47E-06	5.60E-04
Chromium VI	Nd	6.58E-08	6.58E-08	8.30E-05
Dioxins	Nd	2.58E-10	2.58E-10	3.00E-08
Formaldehyde	4.10E-04	1.76E-04	5.85E-04	7.70E-02
Furans	Nd	7.13E-10	7.13E-10	3.00E-08
Nickel	Nd	6.58E-05	6.58E-05	2.10E-03
Polynuclear aromatic hydrocarbons	3.33E-05	Nd	3.33E-05	4.80E-04

Note: Nd refers to no data or stack test results less than the method detection limit.

(a) Annual concentrations based on 15 days of oil firing and 350 days gas-fired with supplemental duct burners.

Estimate the fraction of the emissions from Sumas2 that annually cross into BC.

Based on the Abbotsford wind data collected during 1985 to 1989, we estimate that 53 percent of the emissions from SE2 would cross into British Columbia. MFG calculated this fraction by assuming 100 percent of winds with a southerly component (ESE to WSW), 50 percent of the winds with an easterly or westerly component, and 50 percent of the calm periods transport the SE2 plumes into British Columbia.

The likelihood that winds would carry emissions northward seems to decrease as temperature decreases. We examined wind and temperature data from Abbotsford airport for the same 5-year period we considered in our ISCST3 modeling. When daily average temperatures were less than 0°C but greater than -5°C , there was a net northward flow an average of 3 days per year. When daily average temperatures were less than or equal to -5°C but greater than -10°C , there were two days in 5 years with a net northward flow. The five days (average of one per year) with a daily average temperatures of -10°C or less all show net southward flow. This suggests that emissions on days most likely to result in oil firing would rarely affect Canada.

Calculate the PM10 cumulative sum for the Abbotsford monitoring site (with and without Sumas2), based on three years of data/model output for each season. The cumulative sum of PM10 concentrations is used as an estimate of PM10 exposure, which then forms the basis of health impact estimates. On a seasonal basis, it is calculated by summing total daily PM10 in excess of a reference level ($25 \mu\text{g}/\text{m}^3$) over a season, and then normalizing for the total season (# of days over the reference level/total # of days in a season). When doing this calculation with the predicted Sumas2 PM10 contribution, use the measured 50th percentile concentration as background for the corresponding season. (See Section 5, Addendum 1, PM Science Assessment Document @ http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch_pubs/99ehd220-1.htm)

The median background 24-hr PM10 concentration at Abbotsford is $13.8 \mu\text{g}/\text{m}^3$ based on the 1996 to 1998 data. The highest PM10 concentration from SE2 at the monitoring station would be $1.4 \mu\text{g}/\text{m}^3$. The combined PM10 concentration does not exceed $25 \mu\text{g}/\text{m}^3$ when the median background concentration is used as the basis for the background estimate. Therefore, the cumulative sum would be zero.³

Re: Calpuff

Observations indicated that the Abbotsford area is subject to extended periods of calm during certain times of the year. For primary contaminants, only ISC results were shown, even though ISC cannot accommodate calms. Hence, further information from the Calpuff modeling is requested. In particular:

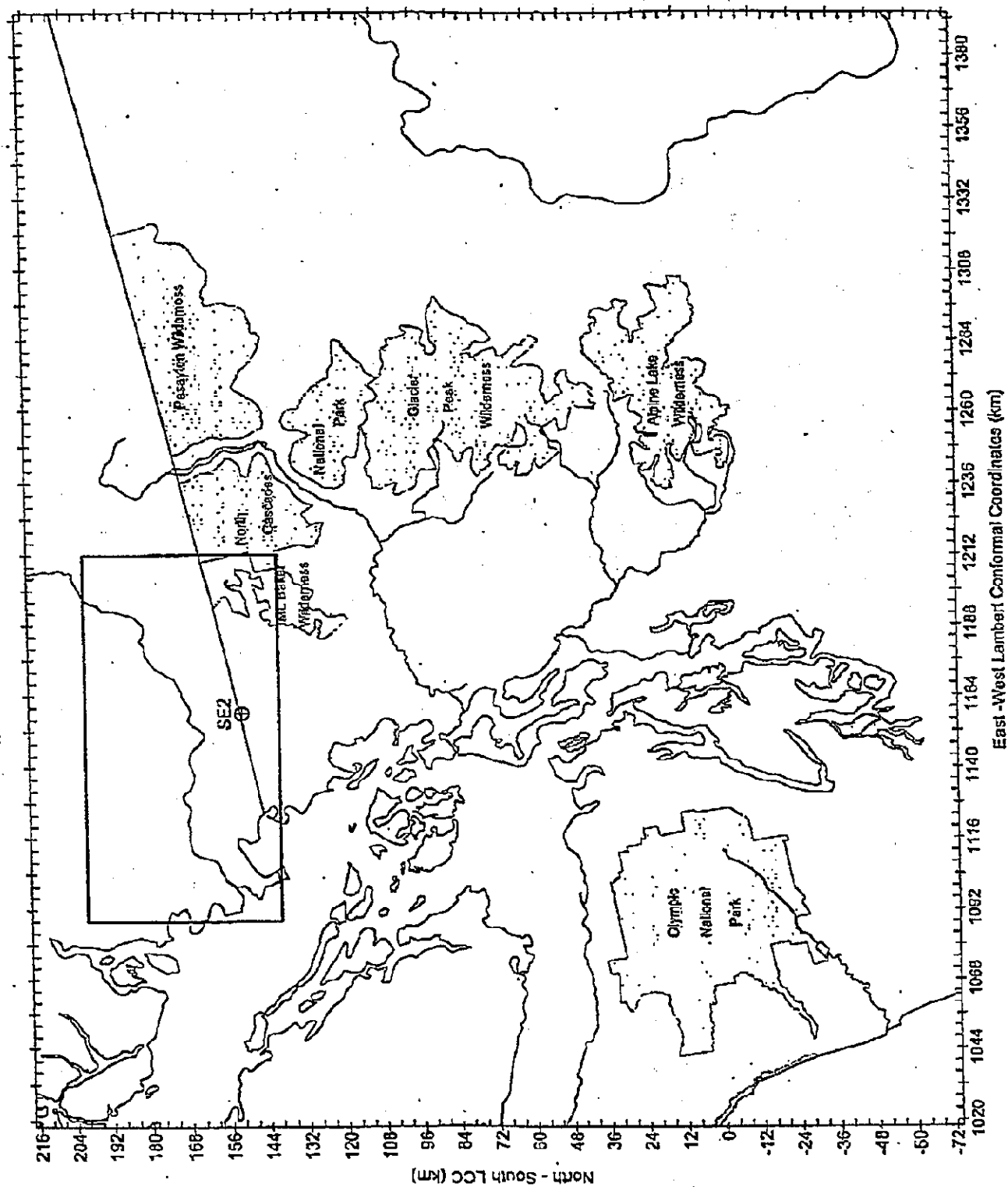
Provide Calpuff-generated tables of PM10 impacts comparable to those presented for ISC.

MFG conducted additional CALPUFF simulations of the SE2 facility in order to respond to the Ministry's request for further information concerning PM10, secondary aerosols, and visibility impacts in the Lower Fraser Valley. The CALPUFF simulations were performed as described in Section 6.1 *Sumas Energy 2 PSD Permit* except that concentrations were calculated on a grid with a smaller mesh size within a smaller study domain. Figure 2 shows the location of the refined sampling grid. Within this area of the Lower Fraser Valley, CALPUFF predicted concentrations were obtained with a mesh size of 1 1/3 km or a nesting factor of 3 from the original 4 km grid used to assess Class I area impacts.

In order to combine secondary aerosol concentrations with concentrations of PM10 directly emitted by SE2, MFG post-processed the CALPUFF output files. Total PM10 concentrations were calculated by summing direct PM10, sulfate, and nitrate concentrations after correcting for the assumed molecular weight of the

³ At the request of Ministry, MFG provided the daily CALPUFF predictions of PM10 including secondary aerosols for the Abbotsford monitoring site. These data were sent to Steve Sakiyama via email on March 23, 2000.

Figure 2. Subset of CALPUFF Model Domain used for PM10
Predictions in the Lower Fraser Valley



resultant secondary aerosols. It was assumed that sulfate and nitrate would be in the form of ammonium sulfate and ammonium nitrate, respectively.

The results of the CALPUFF application to the smaller domain are listed in Table 7 by season and aerosol component for the days with the highest predicted total PM10 concentration from SE2. For the purposes of comparison with the GVRD Interim Air Quality Objective of $50 \mu\text{g}/\text{m}^3$, MFG has listed the observed Abbotsford PM10 concentration on the same days as the prediction. If the Abbotsford background concentration is representative of ambient concentrations, then the total cumulative PM10 concentrations on these days are lower than the $50 \mu\text{g}/\text{m}^3$.

TABLE 7
SEASONAL MAXIMUM 24-HOUR PM10 CONCENTRATIONS
PREDICTED BY CALPUFF FOR THE LOWER FRASER VALLEY

Period	Maximum Predicted 24-hour Concentration ($\mu\text{g}/\text{m}^3$)				Day	Simultaneous Abbotsford PM10 ($\mu\text{g}/\text{m}^3$)
	Total PM10	Direct PM10	(NH ₄)SO ₄	NH ₄ NO ₃		
Spring 98	2.89	2.53	0.046	0.308	4/23/98	15
Summer 98	5.23	4.90	0.088	0.244	7/22/98	25
Fall 98	6.23	5.37	0.100	0.757	9/23/98	27
Winter 98/99	3.44	3.19	0.057	0.188	1/4/99	25
Oil 98/99	8.19	5.51	2.24	0.432	1/4/99	25

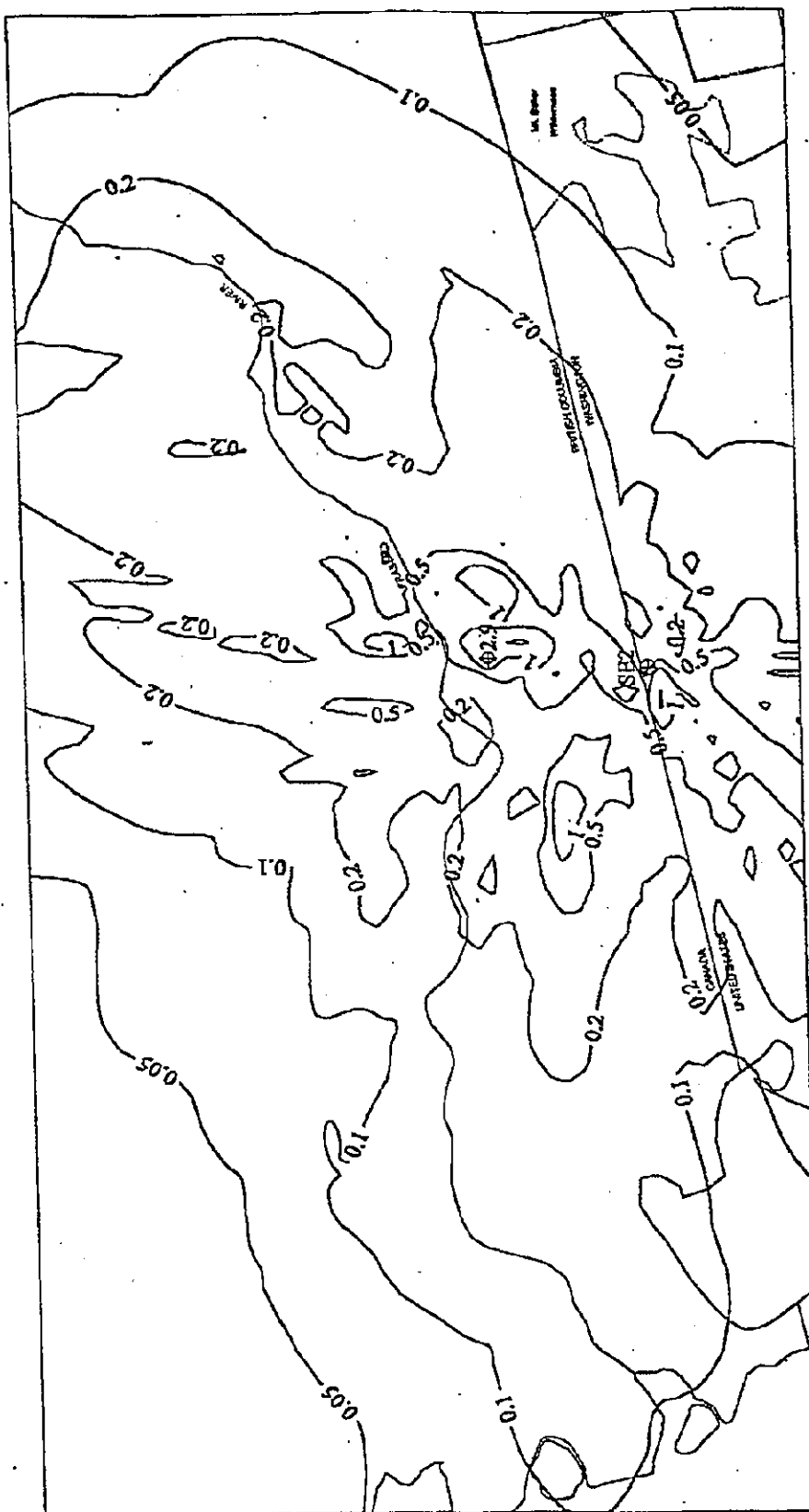
Provide plots of maximum 24 hour PM10 as predicted by CALPUFF for different seasons and a winter oil fired case. Indicate the location and magnitude of the BC maximum and the fraction of PM10 that is secondary in nature.

MFG constructed contour plots of the maximum total PM10 concentrations for the days shown in Table 7 (i.e., the day of each season with the highest PM10 concentration attributable to S2GF). Plots for the four seasons and oil firing are shown in Figure 3 through Figure 7. The requested locations of the maximum predictions, aerosol constituents of the maximum concentration, and date of the maximum are shown in these figures.

Given the plots of deposition shown in Figures 6.1-20,21,22 and 23, indicate BC maxima (including magnitude, location, conditions, frequency of occurrence).

The maximum annual total nitrogen (Figure 6.1-20) and sulfur (Figure 6.1-21) deposition fluxes in Canada are $0.0506 \text{ kg}/\text{ha}/\text{yr}$ and $0.0681 \text{ kg}/\text{ha}/\text{yr}$, respectively. Both maximums occur on Sumas Mountain. Figure 6.1-22 and Figure 6.1-23 do not show deposition fluxes. The period of the predictions is for April 1, 1998 through March 14, 1999. During this period, the Pacific Northwest

Figure 3. Calpuff Predicted Maximum 24-hour PM₁₀ (ug/m³) Including Secondary Aerosols Duct-Fired Case, Spring 1998



Maximum of 2.89 ug/m3 occurred on 4/23/98. Composition of maximum (ug/m3): 1.252 (nitrate), 0.046 (ammonium sulfate), and 0.308 (ammonium nitrate).

Ambisford monitored PM10 on 4/22/98 was 15 ug/m3.

Figure 5. Calpuff Predicted Maximum 24-hour PM₁₀ ($\mu\text{g}/\text{m}^3$) Including Secondary Aerosols
Duct-Fired Case, Fall 1998

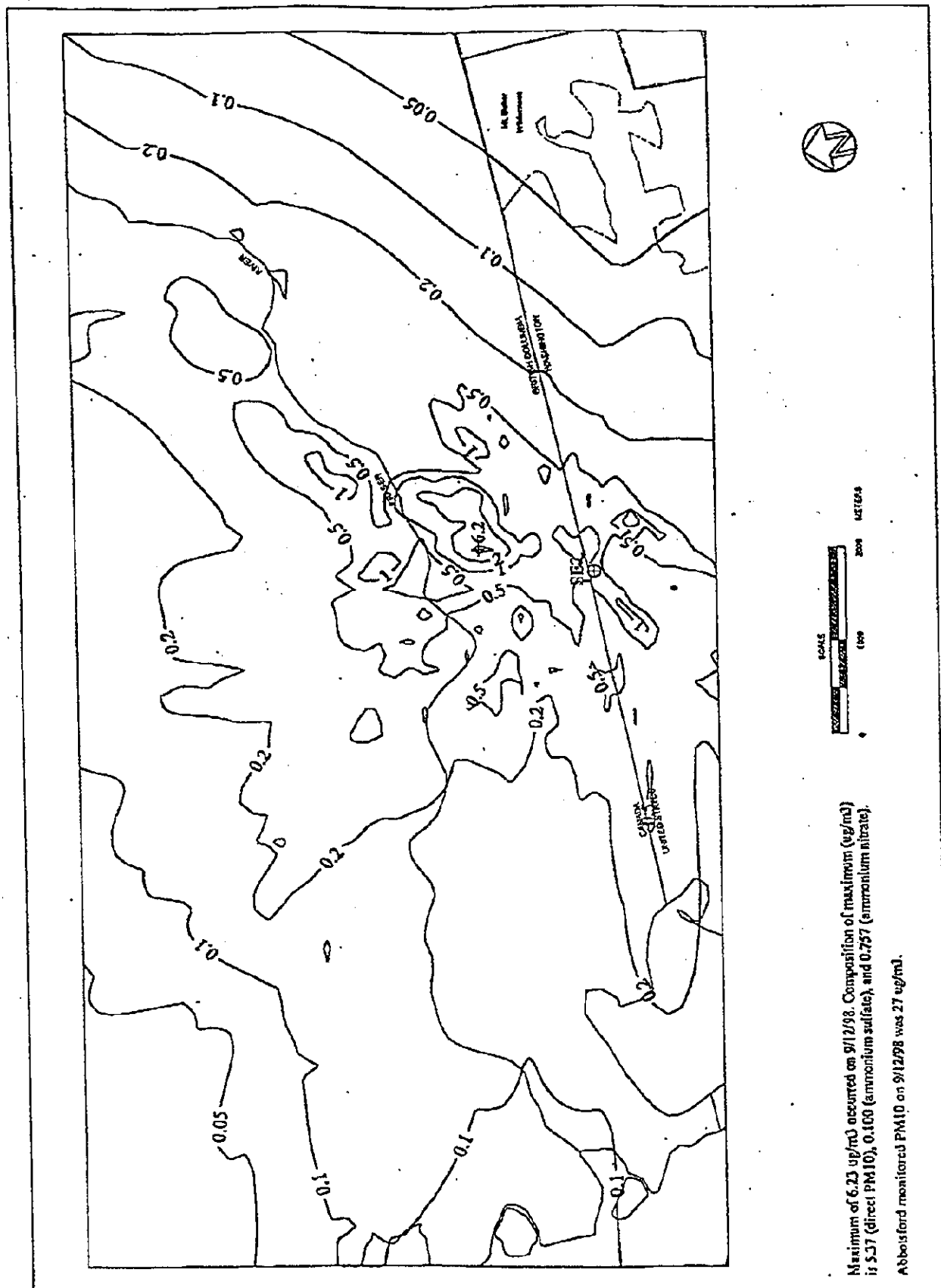


Figure 6. Calpuff Predicted Maximum 24-hour PM10 ($\mu\text{g}/\text{m}^3$) Including Secondary Aerosols
Duct-Fired Case, Winter 1998/1999

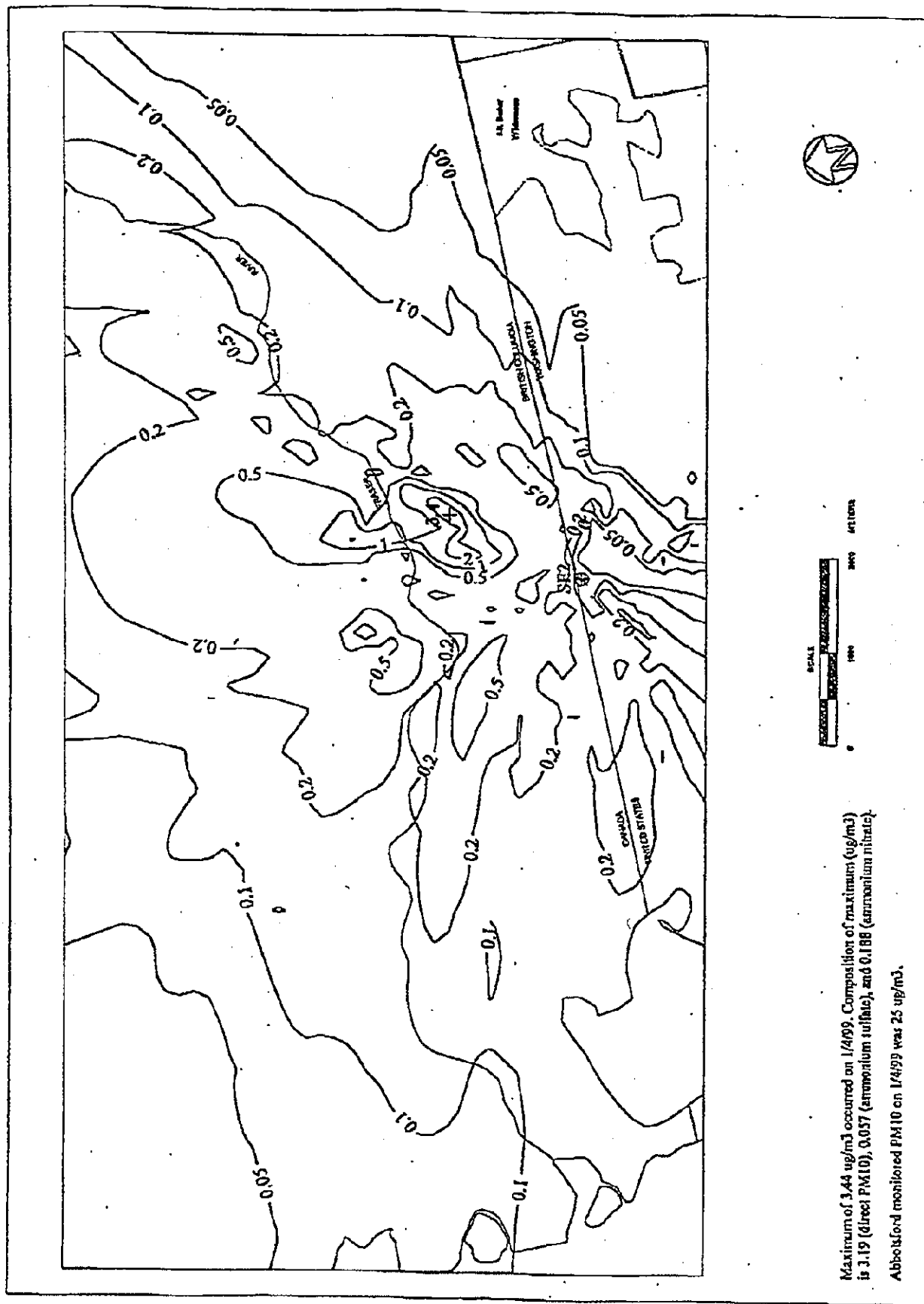
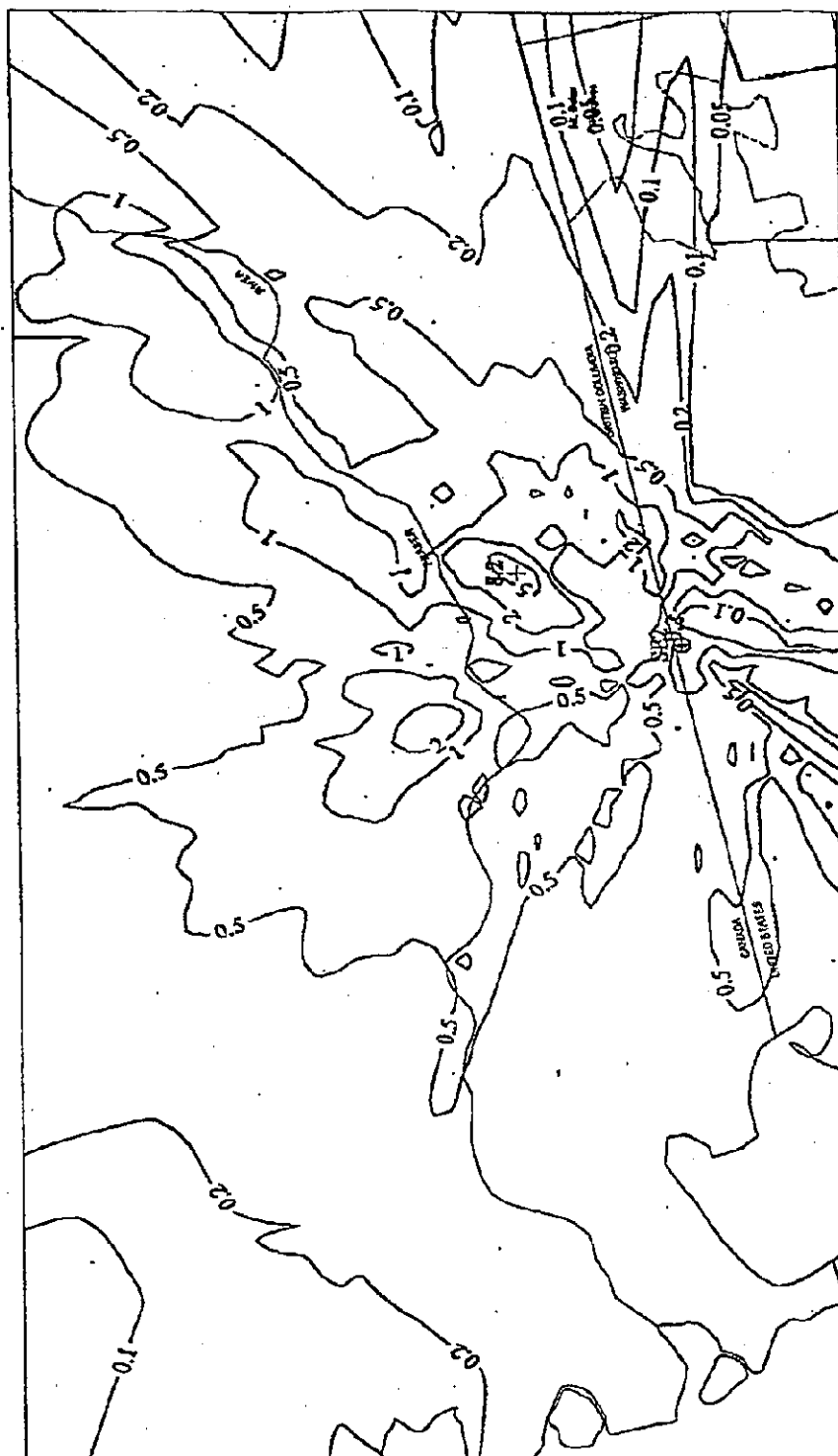


Figure 7. Calpuff Predicted Maximum 24-hour PM10 ($\mu\text{g}/\text{m}^3$) Including Secondary Aerosols
Oil-fired Case, Winter 1998/1999



Maximum of 8.19 $\mu\text{g}/\text{m}^3$ occurred on 1/4/99. Composition of maximum ($\mu\text{g}/\text{m}^3$) is 5.51 (direct PM10), 2.24 (ammonium sulfate), and 0.432 (ammonium nitrate).

Abbotsford monitored PM10 on 1/4/99 was 25 $\mu\text{g}/\text{m}^3$.

experienced a strong *La Nina* with winter precipitation and snow-pack well above normal. The CALPUFF wet deposition estimates are probably conservative due to the above normal precipitation. MFG does not know what affect, if any, the *La Nina* weather regime has on annual dry deposition fluxes.

Given the plots of maximum b_{ext} shown in Figures 6.1-24,25,26,27,28 and 29, indicate BC maxima (including the magnitude, location, conditions, and frequency of occurrence).

The maximum 24-hour extinction coefficients from the requested Figure 6.1-24 to Figure 6.1-28 are summarized in Table 8. Note a more refined analysis is presented in the response to the next comment.

TABLE 8
SUMMARY OF MAXIMUM 24-HOUR EXTINCTION CONCENTRATIONS
PREDICTED BY CALPUFF FOR THE LOWER FRASER VALLEY

Period	Maximum Predicted 24-hour Extinction (1/Mm)	Dist. from SE2 (km)	Direction from SE2	Day
Spring 98	18	20	N	5/16/98
Summer 98	48	9	NNE	7/22/98
Fall 98	38	13	NNE	9/12/98
Winter 98/99	31	14	NNE	1/4/99
Oil 98/99	96	14	NNE	1/4/99

Re: Visibility

Although BC does not have visibility standards in place, visibility is a major issue to residents of the Abbotsford/Chilliwack area. We acknowledge the difficulty of predicting maximum impacts in light of the fact that the baseline values have not been established. To obtain a baseline estimate, the following is suggested to estimate the range of possible visibility impacts:

Use 1 year of IMPROVE-type data collected in the Abbotsford area and generate daily reconstructed best values using the IMPROVE protocol. Calculate the seasonal average of the 20% cleanest days (similar to Class I treatment).

MFG constructed background extinction coefficients for the Abbotsford area based on weekly average nitrate and sulfate concentrations measured by

Environmental Canada from the week of February 6, 1996 through February 25, 1997. PM10 data for the same period were also obtained from the Abbotsford monitoring site. These aerosol concentration data and the components of the extinction coefficient are displayed in Table 9.

MFG calculated the extinction coefficients with the same relationship as used by CALPUFF except that the aerosol concentration data were taken from the summaries shown in Table 9. The general equation applied divides the extinction coefficient into two components as follows:

$$b_{ext} = b_{SN}f(RH) + b_{dry} \quad (1)$$

Where b_{ext} is the extinction coefficient (Mm^{-1}), $f(RH)$ is the relative humidity adjustment factor, b_{SN} is the sulfate and nitrate or hygroscopic portion of the extinction coefficient (Mm^{-1}), and b_{dry} is the non-hygroscopic portion of the extinction coefficient (Mm^{-1}). The hygroscopic portions of the extinction budget was calculated from the sulfate and nitrate concentrations at Abbotsford by CALPUFF according to:

$$b_{SN} = 3[(NH_4)_2SO_4 + NH_4NO_3] \quad (2)$$

where the sulfate and nitrate concentrations have units $\mu g/m^3$ and were converted for the change in molecular weight due to the assumed chemical form of the aerosol. The portion of the extinction coefficient that does not vary with humidity was calculated from:

$$b_{dry} = 4[OC] + 1[Soil Mass] + 0.6[Coarse Mass] + 10[EC] + b_{Ray} \quad (3)$$

Where $[OC]$ is the organic carbon portion of the PM2.5, $[Soil Mass]$ is the crustal portion of the PM2.5, $[Coarse Mass]$ is the portion of the mass between PM2.5 and PM10, $[EC]$ is the elemental carbon (soot) portion of PM10, and b_{Ray} is extinction due to Rayleigh scattering assumed to be $10 Mm^{-1}$. Concentrations in Equation 3 also have units $\mu g/m^3$.

In applying the above relationships to the Abbotsford aerosol data, MFG assumed the PM2.5 fraction was 50 percent of the PM10 concentration after subtracting the ammonium sulfate and nitrate concentrations:

$$PM2.5 = 0.5(PM10 - [(NH_4)_2SO_4 + NH_4NO_3]) \quad (4)$$

MFG assumed the entire remaining PM2.5 fraction consisted of $[Soil Mass]$, and that the carbon fractions ($[EC]$ and $[OC]$) were zero.

Table 9 lists the weekly average components of extinction calculated using Equations 1 to 4. The bottom of Table 9 summarizes the weekly data on a seasonal basis and shows the 10th percentile, median, and 90th percentile coefficients. MFG used the 10th percentile, median and 90th percentile relationships to represent good, average, and poor background visual conditions in the Lower Frazer Valley.

Use the visibility standard for Abbotsford recommended by Pryor (1996) based on a public perception study conducted in the LFV ($b_{sp}=0.039 \times 10^{-3} \text{ m}^{-1} \approx b_{ext}$ of $.063 \times 10^{-3}$ or visual range of $\approx 60 \text{ km}$).

As suggested during our meeting, estimate the incremental Sumas2 impacts on visibility by taking the b_{ext} values as predicted by CALPUFF and producing an average valley-wide b_{ext} (e.g. using the average of the grid point values for the area from the plant to beyond the Abbotsford area – the specific area will be identified later in discussion with MFG).

Calculate the total visibility impact on a seasonal basis by combining either of the two suggested baseline values to the incremental impact. Calculate the seasonal frequency distribution of b_{ext} and deciview (increment/baseline value).

MFG applied the CALPUFF model to predict extinction coefficients along Lines of Sight (LOS) provided by the Ministry. Descriptions of these vistas are listed in Table 10 and the LOS are shown in Figure 8. Note the shaded regions in Figure 8 depict the terrain used in the CALPUFF simulations. MFG placed receptors along the LOS assuming a straight line between the observer and the target. These receptors were treated as "flagpole" receptors because the LOS are above the local terrain in between the target and the observer. For LOS 1 through LOS 4, the receptor interval was 250 m for the first 10 km near the observer and 1 km, thereafter. LOS 5 and LOS 6 were assessed using a receptor spacing of 1 km.

Twenty-four hour average extinction coefficients were calculated for each LOS by post-processing the CALPUFF simulations. Hourly extinction coefficients calculated by CALPUFF using local relative humidity were averaged along each LOS for the SE2 predicted aerosol components and again for SE2 concentrations plus background aerosol concentrations. The simulations were conducted for each season and three background conditions selected to represent good, average, and poor background visual conditions in the Lower Frazer Valley.

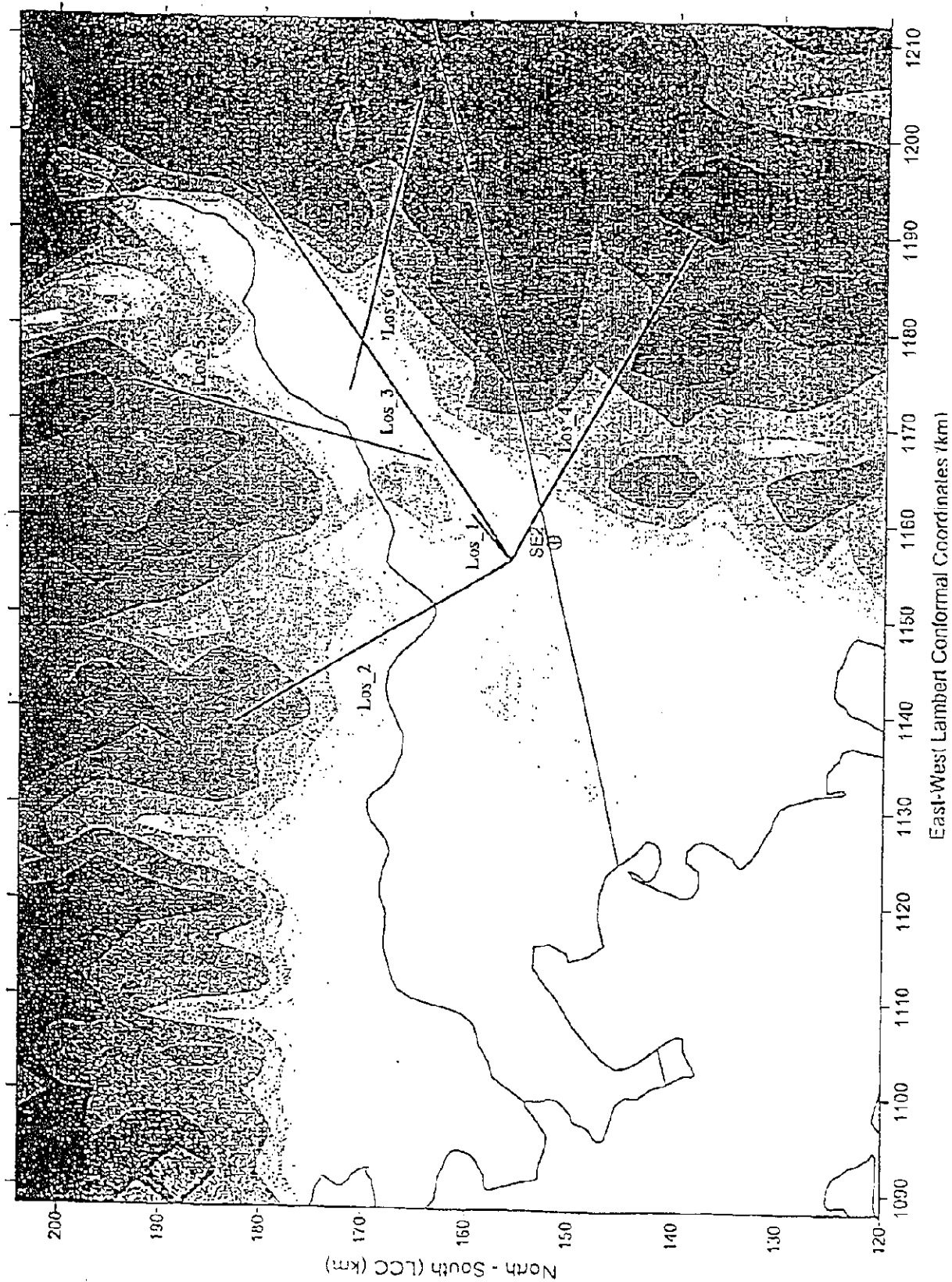
Table 9. Abbotsford Background Aerosol Data and Derived Extinction Components

Week	Weekly Aerosol Concentrations (ug/m3)							Bext (1/Mm)	
	SO4	NO3 as N	NO3	(NH4)2SO4	NH4NO3	Total PM10	PM10 - 2nd's	b_SN	b_dry
6-Feb-96	14.7	0.43	1.90	20.21	2.48	13.4	0.0	88.0	10.0
13-Feb-96	1.47	0.89	3.94	2.02	5.09	32.6	25.5	21.3	30.4
20-Feb-96	1.01	0.25	1.11	1.39	1.43	10.8	8.1	8.5	16.5
27-Feb-96	2.62	0.63	2.78	3.60	3.60	22.9	15.7	21.6	22.5
5-Mar-96	3.43	0.9	3.99	4.72	5.14	13.0	3.1	29.6	12.5
12-Mar-96	2.43	0.55	2.44	3.34	3.14	15.2	8.7	19.5	17.0
19-Mar-96	2.65	0.5	2.21	3.64	2.88	11.0	4.5	18.5	13.6
26-Mar-96	2.48	0.28	1.24	3.41	1.60	9.7	4.7	15.0	13.8
2-Apr-96	2.8	0.67	2.87	3.85	3.83	9.4	1.7	23.0	11.3
8-Apr-96	1.91	0.48	2.13	2.63	2.74	7.2	1.9	16.1	11.5
16-Apr-96	2.07	0.39	1.73	2.85	2.23	9.8	4.7	15.2	13.8
23-Apr-96	2.55	0.24	1.08	3.51	1.37	11.2	6.3	14.6	15.0
30-Apr-96	3.36	0.4	1.77	4.62	2.29	11.1	4.2	20.7	13.3
7-May-96	2.31	0.43	1.90	3.18	2.46	9.7	4.1	16.9	13.3
14-May-96									
21-May-96									
28-May-96									
4-Jun-96									
11-Jun-96	3.98	0.65	2.88	5.45	3.71	16.0	6.8	27.5	15.4
18-Jun-96	4.01	0.78	3.45	5.51	4.45	19.4	9.5	29.9	17.6
25-Jun-96	3.34	0.6	2.66	4.59	3.43	15.5	7.5	24.1	16.0
2-Jul-96	3.75	0.58	2.57	5.16	3.31	17.6	9.2	25.4	17.3
9-Jul-96	5.49	0.76	3.37	7.55	4.34	26.2	14.3	35.7	21.4
16-Jul-96	3.5	0.75	3.32	4.81	4.29	14.4	5.3	27.3	14.3
23-Jul-96	5.52	1.04	4.61	7.59	5.94	36.3	22.8	40.6	28.2
30-Jul-96	4.44	0.37	1.64	6.11	2.11	17.1	8.8	24.7	17.1
6-Aug-96	4.86	1.1	4.87	6.68	6.29			38.9	
13-Aug-96	4.86	0.37	1.64	6.68	2.11			26.4	
20-Aug-96	5.54	0.87	3.85	7.62	4.97			37.8	
27-Aug-96	4.41	0.68	3.01	6.06	3.89			29.8	
3-Sep-96	1.94	0.34	1.51	2.67	1.94			13.8	
10-Sep-96	3.28	0.64	2.83	4.51	3.66			24.5	
17-Sep-96	3.12	0.64	2.83	4.29	3.66	20.4	12.5	23.8	20.0
24-Sep-96	3.98	0.99	4.38	5.47	5.66	24.1	12.9	33.4	20.3
1-Oct-96	1.32	0.44	1.95	1.82	2.51	19.2	14.8	13.0	21.9
8-Oct-96	0.56	0.23	1.02	0.77	1.31	16.4	14.3	6.3	21.4
15-Oct-96	1.17	0.23	1.02	1.61	1.31	11.7	8.8	8.8	17.5
22-Oct-96	1.1	0.31	1.37	1.51	1.77	15.8	12.5	9.9	20.0
29-Oct-96	1.23	0.16	0.71	1.69	0.91	21.3	18.7	7.8	24.9
5-Nov-96	0.95	0.2	0.89	1.31	1.14	14.4	11.9	7.3	19.6
12-Nov-96	1.3	0.27	1.20	1.79	1.54	9.9	6.6	10.0	15.2
19-Nov-96						14.8	14.8		21.6
26-Nov-96	1.17	0.15	0.66	1.61	0.86	10.7	8.3	7.4	16.6
3-Dec-96	0.82	0.27	1.20	1.13	1.54	11.2	8.5	8.0	16.6
10-Dec-96	0.93	0.23	1.02	1.28	1.31	10.1	7.5	7.8	16.0
17-Dec-96	0.76	0.31	1.37	1.05	1.77	17.4	14.6	8.4	21.7
24-Dec-96	0.68	0.09	0.40	0.94	0.51	6.8	5.4	4.3	14.3
31-Dec-96	1.07	0.33	1.46	1.47	1.89			10.1	
7-Jan-97	1.44	0.25	1.11	1.98	1.43			10.2	
14-Jan-97	0.97	0.26	1.15	1.33	1.49			8.5	
21-Jan-97	1.4	0.25	1.11	1.93	1.43			10.1	

so4_no3.xls, bext1

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Figure 8. Lines of Sight Used for Calculation of Path Length
Average Extinction Coefficients



MFG evaluated the potential impacts of SE2 emissions on visibility in the Lower Frazer Valley using two criteria. The criteria are designed to assess: 1) whether visibility would be impaired based on public perception and 2) whether a change in extinction would cause a noticeable difference on days with good background visibility. The two criteria applied were as follows:

- MFG used a visual range of 60 km or less as an indicator of a day with impaired visibility based on the visibility perception study conducted by Pryor in Abbotsford.⁴ A visual range of 60 km is equivalent to an extinction coefficient of 65.2 (1/Mm).
- A change in extinction of five percent from background conditions was used by MFG as an indicator of a just perceptible change to a vista caused by SE2 aerosol concentrations. This was the same criteria applied in the Class I area assessment described in *Section 6.1 Sumas Energy 2 PSD Permit*.

Table 11 shows the frequency of impaired visibility days for each season and LOS based on the background aerosol data presented in Table 9. This table does not include the contribution of SE2. The extinction coefficients were path averaged along each LOS using the spatial relative humidity data in the CALPUFF simulations from April 1, 1998 through March 14, 1999. Table 11 indicates the best visibility conditions are in the winter and fall. During the summer, even the 10th percentile aerosol concentration resulted in impaired visibility (visual range less than 60 km). In Table 11 the differences between the numbers of visibility impaired days by LOS for a given background aerosol concentration and season are due to differences in relative humidity along the LOS.

Table 12 through Table 15 display the results of the CALPUFF simulations where frequency distributions of the path-averaged extinction coefficients are presented by season, LOS, and background condition. Table 16 shows the results for the oil-fired scenario. Frequency distributions are shown for both the total extinction and the change to background extinction. For example, in Table 12 for Spring 1998, the simulations predict SE2 would cause a 3.3 percent increased probability of visibility impaired days along LOS 1 on days with good visibility (i.e., low background (10th percentile) aerosol concentrations). For this same combination during the summer of 1998 (Table 13), SE2 is not predicted to cause an increase in the number of visibility impaired days. However, the change in extinction along LOS 1 due to SE2 during the summer is predicted to cause a perceptible change to the vista on 2.17 percent of the days with low background concentrations.

⁴ Pryor, S.C., 1996. Assessing the Public Perception of Visibility for Standard Setting Exercises. *Atmos. Environ.*, Vol. 30, pp. 2704 to 2716.

Table 11. Frequency of Impaired Visibility by Line of Sight for Different Background Conditions without SE2

Low (10%) Background Aerosol Concentration						
Season	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Spring	57.4%	73.8%	63.9%	57.4%	65.6%	67.2%
Summer	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Fall	36.3%	42.9%	38.5%	36.3%	36.3%	37.4%
Winter	22.1%	22.1%	15.4%	23.1%	15.4%	16.3%
Median (50%) Background Aerosol Concentration						
Season	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Spring	86.9%	90.2%	80.3%	86.9%	77.0%	75.4%
Summer	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Fall	79.1%	86.8%	75.8%	79.1%	74.7%	76.9%
Winter	59.6%	62.5%	35.6%	59.6%	26.9%	22.1%
High (90%) Background Aerosol Concentration						
Season	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Spring	93.4%	96.7%	93.4%	93.4%	90.2%	82.0%
Summer	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Fall	100.0%	100.0%	100.0%	100.0%	100.0%	97.8%
Winter	97.1%	98.1%	97.1%	97.1%	97.1%	95.2%
Impaired visibility is based on an extinction coefficient greater than 65.2 (1/Mm)						

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Table 12. Calpuff Modeling Results by Line of Sight for Different Background Conditions

Duct-Fired Emissions, Spring 1998 Meteorology												
Table 12. Calpuff Modeling Results by Line of Sight for Different Background Conditions												
Change in Bext (1/fMm) from Low (10%) Background												
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	159.9	159.5	161.4	160.0	160.0	160.4	6.79%	4.53%	3.68%	2.26%	5.37%	1.43%
Average	75.7	80.8	77.6	75.3	79.2	78.5	1.32%	0.64%	0.87%	0.66%	1.00%	0.24%
Minimum	33.9	41.7	30.6	33.9	29.0	27.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	149.1	151.8	144.2	148.8	143.5	142.3	4.76%	3.09%	3.03%	1.64%	3.55%	1.06%
95.00%	123.8	126.5	133.7	122.6	132.2	127.1	3.53%	2.66%	2.30%	1.61%	3.00%	0.89%
90.00%	102.6	105.3	103.4	102.6	105.1	108.0	3.35%	1.95%	1.86%	1.25%	2.96%	0.82%
80.00%	89.9	93.9	92.6	89.4	93.9	100.9	2.03%	1.05%	1.54%	0.89%	2.05%	0.36%
75.00%	86.7	89.8	88.6	86.0	90.2	94.0	1.93%	0.88%	1.31%	0.97%	1.57%	0.34%
50.00%	70.4	74.4	77.4	69.0	81.3	79.5	0.90%	0.25%	0.65%	0.61%	0.58%	0.08%
Days with Perceptible Reduced Visual Range (%)												
3.3%	0.0%	0.0%	0.0%	1.6%	1.6%	0.0%	1.64%	0.00%	0.00%	0.00%	1.64%	0.00%
Change in Bext (1/fMm) from Median (50%) Background												
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	193.7	192.1	195.2	193.8	193.8	194.3	5.92%	3.76%	3.22%	1.89%	4.45%	1.23%
Average	91.4	97.6	93.7	91.0	94.5	94.9	1.09%	0.53%	0.72%	0.55%	0.82%	0.19%
Minimum	40.7	50.2	36.7	40.7	34.8	32.7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	180.6	184.1	174.6	180.3	173.8	172.5	3.94%	2.56%	2.51%	1.52%	2.93%	0.88%
95.00%	149.5	153.0	161.6	149.3	159.6	163.9	2.92%	2.20%	1.90%	1.33%	2.48%	0.81%
90.00%	124.3	127.5	125.2	124.3	128.8	130.7	2.77%	1.61%	1.54%	1.04%	2.45%	0.68%
80.00%	108.7	113.7	112.1	108.2	119.4	122.2	1.69%	0.87%	1.27%	0.82%	1.70%	0.30%
75.00%	104.7	108.5	107.1	104.0	109.0	113.8	1.59%	0.72%	1.08%	0.80%	1.30%	0.28%
50.00%	84.7	89.9	83.4	83.3	88.0	96.1	0.74%	0.21%	0.54%	0.50%	0.47%	0.07%
Days with Perceptible Reduced Visual Range (%)												
0.0%	0.0%	0.0%	3.3%	0.0%	1.6%	0.0%	1.64%	0.00%	0.00%	0.00%	0.00%	0.00%
Change in Bext (1/fMm) from High (90%) Background												
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	225.2	223.4	228.8	225.3	225.4	225.9	4.84%	3.24%	2.77%	1.63%	3.83%	1.06%
Average	105.0	113.4	108.8	105.7	109.7	110.2	0.94%	0.46%	0.62%	0.47%	0.71%	0.17%
Minimum	47.2	53.2	42.5	47.2	40.3	37.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	209.9	214.2	203.0	209.7	202.0	200.6	3.39%	2.20%	2.16%	1.31%	2.52%	0.75%
95.00%	173.5	177.8	187.7	172.3	185.1	178.9	2.51%	1.90%	1.64%	1.14%	2.13%	0.70%
90.00%	144.5	148.3	145.0	144.5	147.3	152.0	2.39%	1.38%	1.32%	0.89%	2.11%	0.58%
80.00%	126.2	132.2	130.2	125.7	138.6	142.0	1.46%	0.75%	1.09%	0.70%	1.46%	0.26%
75.00%	121.5	126.3	124.5	120.6	128.6	132.2	1.37%	0.62%	0.93%	0.69%	1.12%	0.24%
50.00%	97.8	104.4	108.4	96.7	113.7	111.7	0.64%	0.16%	0.46%	0.43%	0.41%	0.05%
Days with Perceptible Reduced Visual Range (%)												
1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Note: Days with impaired visibility based on Bext greater than 55.2 (1/fMm). Days with perceptible reduced visual range based on a change in Bext greater than 5 percent												

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los_bext.xls, Spring Tables

Table 13. Calpuff Modeling Results by Line of Sight for Different Background Conditions

Duct-Fired Emissions, Summer 1998 Meteorology

	Total Bx1 (1/ftm) with Low (10%) Background						Change in Bx1 (1/ftm) from Low (10%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	225.1	236.3	230.8	224.9	232.2	234.3	6.12%	3.62%	5.25%	3.78%	5.68%	1.56%
Average	119.8	129.4	129.5	119.5	132.7	134.8	1.49%	0.32%	1.26%	1.13%	1.43%	0.26%
Minimum	70.6	76.6	69.5	70.0	69.6	67.3	0.00%	0.00%	0.01%	0.06%	0.00%	0.00%
98.00%	197.0	208.3	208.0	196.6	215.3	223.3	4.64%	2.10%	3.76%	3.07%	4.73%	0.94%
95.00%	175.6	172.0	187.7	174.4	192.0	200.8	3.44%	1.67%	3.39%	2.53%	4.21%	0.85%
90.00%	149.9	160.7	157.0	148.8	167.8	177.4	2.80%	1.13%	2.70%	2.19%	3.23%	0.55%
80.00%	133.5	144.3	144.9	133.6	149.4	148.0	2.05%	0.37%	2.09%	1.78%	2.17%	0.43%
75.00%	129.4	140.3	139.9	128.7	142.8	146.4	1.96%	0.32%	1.80%	1.64%	1.77%	0.39%
50.00%	116.2	126.5	125.1	115.7	129.4	132.6	1.18%	0.02%	0.81%	1.00%	1.11%	0.22%
Increase in Days with Impaired Visibility												
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.17%	0.00%	1.09%	0.00%	2.17%	0.00%
Days with Perceptible Reduced Visual Range (%)												
Total Bx1 (1/ftm) with Median (50%) Background												
Maximum	264.0	277.4	270.8	263.9	272.5	275.0	6.95%	3.09%	4.48%	3.23%	4.78%	1.34%
Average	139.8	151.3	151.3	139.5	154.9	157.7	1.28%	0.28%	1.08%	0.97%	1.23%	0.24%
Minimum	81.9	89.0	80.8	81.4	80.8	78.3	0.00%	0.00%	0.01%	0.05%	0.00%	0.00%
98.00%	230.9	244.3	243.8	230.6	252.4	261.9	3.97%	1.79%	3.21%	2.63%	4.04%	0.81%
95.00%	205.5	201.6	219.9	204.3	224.8	235.6	2.94%	1.43%	2.80%	2.17%	3.60%	0.73%
90.00%	175.2	188.3	183.8	174.1	196.3	207.9	2.39%	0.97%	2.31%	1.87%	2.76%	0.47%
80.00%	155.9	168.9	169.5	156.2	174.0	173.3	1.75%	0.32%	1.78%	1.52%	1.65%	0.37%
75.00%	151.0	164.2	163.6	150.5	166.9	171.4	1.68%	0.28%	1.54%	1.41%	1.51%	0.33%
50.00%	135.8	147.9	147.4	135.1	151.1	155.1	1.01%	0.01%	0.78%	0.86%	0.95%	0.19%
Increase in Days with Impaired Visibility												
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.17%	0.00%	0.00%	0.00%	0.00%	0.00%
Days with Perceptible Reduced Visual Range (%)												
Total Bx1 (1/ftm) with High (90%) Background												
Maximum	359.5	377.9	359.0	359.5	371.3	374.7	5.10%	2.27%	3.29%	2.37%	3.51%	0.88%
Average	190.0	206.2	205.6	188.8	210.5	214.8	0.94%	0.20%	0.78%	0.71%	0.90%	0.18%
Minimum	111.2	121.1	110.0	110.7	110.0	106.8	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%
98.00%	314.3	332.9	331.8	314.1	343.6	356.8	2.91%	1.32%	2.35%	1.93%	2.96%	0.59%
95.00%	279.3	274.7	298.6	278.3	305.2	321.0	2.16%	1.05%	2.12%	1.59%	2.64%	0.53%
90.00%	230.2	256.7	250.2	237.1	265.6	283.4	1.76%	0.71%	1.70%	1.37%	2.02%	0.34%
80.00%	212.1	230.2	230.8	212.5	235.5	236.1	1.29%	0.24%	1.31%	1.12%	1.38%	0.27%
75.00%	205.1	223.8	222.8	204.6	227.0	233.5	1.23%	0.20%	1.13%	1.03%	1.11%	0.24%
50.00%	184.6	201.6	200.8	193.7	205.2	211.4	0.74%	0.01%	0.57%	0.63%	0.70%	0.14%
Increase in Days with Impaired Visibility												
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.09%	0.00%	0.00%	0.00%	0.00%	0.00%
Days with Perceptible Reduced Visual Range (%)												

Note: Days with impaired visibility based on Bx1 greater than 65.2 (1/ftm). Days with perceptible reduced visual range based on a change in Bx1 greater than 5 percent

Table 14. Calpuff Modeling Results by Line of Sight for Different Background Conditions

Duct-Fired Emissions, Fall 1998 Meteorology

	Total Bext (1/Mm) with Low (10%) Background						Change in Bext (1/Mm) from Low (10%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	90.2	89.6	85.1	69.6	67.4	80.5	12.37%	6.26%	15.53%	8.41%	16.96%	3.70%
Average	61.4	64.8	61.9	61.2	62.1	61.6	1.85%	0.89%	1.48%	1.50%	1.57%	0.35%
Minimum	37.1	36.6	37.5	37.6	33.8	20.3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	86.4	86.1	83.9	84.2	86.7	87.7	8.44%	4.38%	5.20%	8.11%	10.17%	1.85%
95.00%	81.0	82.8	82.9	80.5	83.7	86.7	6.12%	3.44%	4.81%	5.79%	5.78%	1.55%
90.00%	77.2	79.5	80.2	76.8	81.1	83.5	4.70%	2.38%	3.99%	4.48%	4.65%	1.10%
80.00%	73.0	75.3	73.4	72.9	74.3	75.2	2.63%	1.52%	2.93%	2.36%	2.74%	0.59%
75.00%	71.2	74.4	70.4	70.4	70.8	72.2	2.30%	1.31%	1.78%	1.75%	1.89%	0.48%
50.00%	60.4	64.5	62.0	59.9	62.0	61.7	1.26%	0.32%	0.58%	0.60%	0.39%	0.06%
Increase in Days with Impaired Visibility												
	0.0%	5.5%	1.1%	0.0%	4.4%	0.0%	8.79%	1.10%	5.49%	6.58%	6.58%	0.00%
Days with Perceptible Reduced Visual Range (%)												
	Total Bext (1/Mm) with Median (50%) Background						Change in Bext (1/Mm) from Median (50%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	119.1	118.6	112.0	118.8	114.6	119.7	9.47%	4.76%	11.95%	6.44%	12.28%	2.83%
Average	80.1	84.8	80.8	79.9	81.0	80.7	1.42%	0.69%	1.13%	1.15%	1.20%	0.27%
Minimum	47.6	49.5	48.2	48.3	43.1	37.2	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	112.1	113.6	110.7	111.2	114.2	116.0	6.43%	3.34%	3.89%	6.27%	7.83%	1.41%
95.00%	106.7	108.9	108.9	106.2	110.5	114.6	4.70%	2.62%	3.69%	4.44%	4.41%	1.21%
90.00%	101.4	104.5	105.7	101.1	106.9	110.1	3.65%	1.81%	3.11%	3.46%	3.59%	0.84%
80.00%	95.9	98.8	96.5	96.0	97.8	99.1	2.04%	1.17%	2.24%	1.83%	2.13%	0.45%
75.00%	93.2	97.9	92.5	92.4	92.9	94.9	1.76%	1.00%	1.56%	1.34%	1.44%	0.37%
50.00%	78.7	84.6	80.4	77.6	80.9	80.9	0.56%	0.24%	0.42%	0.46%	0.30%	0.06%
Increase in Days with Impaired Visibility												
	1.1%	1.1%	3.3%	0.0%	3.3%	0.0%	4.40%	0.00%	2.20%	5.49%	4.40%	0.00%
Days with Perceptible Reduced Visual Range (%)												
	Total Bext (1/Mm) with High (90%) Background						Change in Bext (1/Mm) from High (90%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	265.3	264.6	248.1	265.1	264.7	287.4	4.53%	2.21%	5.80%	3.18%	6.07%	1.36%
Average	168.4	180.7	170.5	168.4	170.9	171.0	0.68%	0.32%	0.55%	0.57%	0.50%	0.13%
Minimum	89.9	93.7	91.2	90.5	78.9	64.1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	246.5	251.8	244.7	245.5	249.1	268.2	2.99%	1.57%	2.31%	3.10%	3.86%	0.68%
95.00%	234.3	240.3	235.7	234.0	244.2	254.8	2.30%	1.22%	1.78%	2.17%	2.08%	0.57%
90.00%	221.3	229.0	232.9	221.1	235.6	243.1	1.86%	0.85%	1.59%	1.77%	1.88%	0.41%
80.00%	206.7	214.7	209.9	208.8	213.0	216.7	0.98%	0.57%	1.07%	0.92%	1.13%	0.21%
75.00%	200.2	212.2	200.1	199.5	199.2	205.8	0.82%	0.48%	0.64%	0.65%	0.68%	0.18%
50.00%	153.9	179.2	170.2	163.8	171.9	171.8	0.44%	0.11%	0.20%	0.22%	0.15%	0.03%
Increase in Days with Impaired Visibility												
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%	0.00%	1.10%	0.00%	1.10%	0.00%
Days with Perceptible Reduced Visual Range (%)												

Note: Days with impaired visibility based on Bext greater than 65.2 (1/Mm). Days with perceptible reduced visual range based on a change in Bext greater than 5 percent

4/16/00, 2:55 PM

los_bext.xls, Fall Tables

Table 15. Calpuff Modeling Results by Line of Sight for Different Background Conditions

Duct-Fired Emissions, Winter 1998/1999 Meteorology

	Total Bext (1/fMm) with Low (10%) Background						Change in Bext (1/fMm) from Low (10%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	66.0	63.6	68.6	65.6	60.5	60.7	7.95%	5.22%	5.11%	2.56%	11.81%	1.31%
Average	55.9	55.2	50.1	55.5	48.3	46.0	1.52%	0.63%	0.82%	0.63%	0.98%	0.14%
Minimum	22.3	22.3	22.6	22.3	22.7	22.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	85.2	79.4	80.4	84.3	84.4	86.4	4.28%	4.41%	3.11%	1.76%	5.59%	0.58%
95.00%	78.7	77.5	78.5	76.8	82.2	86.4	3.84%	3.02%	2.42%	1.59%	3.21%	0.50%
90.00%	73.5	72.7	72.8	73.2	73.6	76.6	3.25%	1.63%	1.71%	1.27%	1.95%	0.41%
80.00%	67.8	66.5	62.2	67.4	59.1	53.1	2.52%	0.90%	1.31%	1.01%	1.45%	0.24%
75.00%	65.1	63.5	57.9	64.5	54.3	48.5	2.10%	0.74%	1.17%	0.83%	1.21%	0.18%
50.00%	56.7	56.7	47.4	56.4	44.9	41.2	1.21%	0.20%	0.58%	0.51%	0.64%	0.03%
Increase in Days with Impaired Visibility												
1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.92%	0.96%	0.96%	0.00%	2.83%	0.00%
Days with Perceptible Reduced Visual Range (%)												
Total Bext (1/fMm) with Median (50%) Background												
Maximum	111.4	109.3	114.9	111.0	117.1	117.8	6.33%	4.08%	4.02%	1.99%	9.42%	1.04%
Average	71.3	70.6	63.8	71.0	61.5	58.5	1.19%	0.50%	0.65%	0.49%	0.77%	0.11%
Minimum	27.0	27.1	27.5	27.1	27.6	27.7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	110.1	102.8	103.9	109.2	109.2	117.0	3.33%	3.49%	2.48%	1.40%	4.48%	0.46%
95.00%	101.2	100.2	101.5	99.3	106.6	112.1	2.83%	2.38%	1.90%	1.24%	2.60%	0.39%
90.00%	94.8	94.9	93.7	94.5	94.8	99.1	2.55%	1.27%	1.34%	1.01%	1.54%	0.32%
80.00%	87.2	85.6	79.9	86.7	75.5	67.9	2.03%	0.70%	1.02%	0.80%	1.14%	0.19%
75.00%	83.4	81.6	74.2	83.0	68.9	61.8	1.64%	0.58%	0.91%	0.73%	0.96%	0.14%
50.00%	72.2	72.7	60.2	72.2	56.8	52.1	0.94%	0.15%	0.45%	0.40%	0.51%	0.02%
Increase in Days with Impaired Visibility												
1.0%	1.0%	1.0%	1.5%	1.0%	0.0%	0.0%	0.96%	0.00%	0.00%	0.00%	1.92%	0.00%
Days with Perceptible Reduced Visual Range (%)												
Total Bext (1/fMm) with High (90%) Background												
Maximum	240.4	233.3	246.7	240.2	252.9	256.1	3.22%	1.96%	1.98%	0.94%	4.71%	0.53%
Average	147.9	146.8	131.1	147.7	125.6	119.2	0.58%	0.24%	0.32%	0.24%	0.38%	0.05%
Minimum	46.9	47.1	47.9	47.0	48.1	48.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	236.7	221.4	222.8	236.0	236.1	254.1	1.58%	1.75%	1.27%	0.71%	2.29%	0.24%
95.00%	214.8	211.4	216.2	213.0	230.1	242.6	1.39%	1.17%	0.93%	0.59%	1.38%	0.20%
90.00%	202.6	201.0	199.3	202.1	201.9	212.7	1.26%	0.60%	0.65%	0.49%	0.77%	0.16%
80.00%	184.1	181.3	166.3	183.6	157.3	141.0	1.01%	0.33%	0.49%	0.39%	0.55%	0.09%
75.00%	175.7	172.6	155.2	175.5	142.1	126.9	0.80%	0.28%	0.45%	0.35%	0.47%	0.07%
50.00%	150.3	152.0	122.9	150.4	114.6	104.5	0.45%	0.08%	0.22%	0.19%	0.24%	0.01%
Increase in Days with Impaired Visibility												
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Days with Perceptible Reduced Visual Range (%)												

Note:

Days with impaired visibility based on Bext greater than 65.2 (1/fMm). Days with perceptible reduced visual range based on a change in Bext greater than 5 percent

Table 16. Calpuff Modeling Results by Line of Sight for Different Background Conditions

Oil-Fired Emissions, Winter 1998/1999 Meteorology

	Total Bext (1/Mm) with Low (10%) Background						Change in Bext (1/Mm) from Low (10%) Background					
	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6	Los_1	Los_2	Los_3	Los_4	Los_5	Los_6
Maximum	89.2	85.0	69.7	66.0	66.0	60.7	13.33%	20.86%	20.39%	15.47%	47.30%	3.94%
Average	58.0	57.4	52.8	57.8	51.5	47.7	3.88%	1.84%	3.25%	2.31%	4.27%	0.56%
Minimum	22.3	22.3	22.6	22.3	22.7	22.8	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	87.7	81.4	64.8	65.0	67.9	60.2	10.45%	13.35%	14.67%	7.70%	25.91%	2.40%
95.00%	81.7	78.8	79.5	79.7	83.8	87.7	9.76%	10.68%	9.53%	6.07%	16.70%	1.91%
90.00%	76.0	73.0	75.9	76.1	78.4	81.0	8.22%	5.56%	7.20%	4.87%	9.13%	1.74%
80.00%	73.5	68.1	65.8	71.3	64.2	56.9	6.31%	2.32%	5.26%	3.40%	5.53%	1.25%
75.00%	68.9	66.4	61.2	68.1	60.0	51.6	5.69%	1.67%	4.21%	2.78%	4.94%	0.85%
50.00%	59.4	59.2	50.8	58.5	47.0	42.0	3.03%	0.46%	1.94%	1.67%	2.62%	0.18%
Days with Perceptible Reduced Visual Range (%)												
7.8%	3.3%	3.3%	3.3%	3.3%	2.2%	0.0%	25.56%	12.22%	21.11%	8.89%	23.33%	0.00%
Total Bext (1/Mm) with Median (50%) Background												
Maximum	114.2	109.6	115.0	111.4	122.7	117.9	10.35%	16.29%	16.05%	12.03%	37.42%	3.11%
Average	74.5	73.2	67.0	73.8	65.1	60.7	3.04%	1.51%	2.55%	1.80%	3.56%	0.44%
Minimum	27.0	27.1	27.5	27.1	27.6	27.7	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	113.0	104.8	108.6	110.0	112.9	117.1	9.20%	10.47%	11.68%	5.02%	20.28%	1.90%
95.00%	104.7	102.0	102.9	102.8	108.1	113.8	7.63%	8.39%	7.44%	4.76%	13.05%	1.50%
90.00%	97.7	94.3	97.9	98.0	100.9	104.8	6.39%	4.32%	5.65%	3.78%	7.22%	1.38%
80.00%	84.1	87.8	83.8	80.4	78.2	72.8	4.95%	1.80%	4.11%	2.67%	4.39%	0.55%
75.00%	87.7	85.1	78.1	87.3	76.8	65.7	4.40%	1.30%	3.31%	2.19%	3.82%	0.68%
50.00%	75.3	75.6	63.9	74.5	59.6	53.1	2.40%	0.37%	1.53%	1.32%	2.07%	0.14%
Days with Perceptible Reduced Visual Range (%)												
2.2%	2.2%	2.2%	7.0%	1.1%	4.4%	0.0%	20.00%	10.00%	17.78%	3.33%	16.67%	0.00%
Total Bext (1/Mm) with High (90%) Background												
Maximum	241.9	234.6	249.9	240.6	258.5	256.1	4.91%	7.82%	7.89%	5.70%	18.68%	1.54%
Average	153.5	151.9	135.9	152.8	131.9	124.2	1.47%	0.73%	1.24%	0.87%	1.65%	0.22%
Minimum	45.9	47.1	47.9	47.0	48.1	48.5	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
98.00%	240.5	222.3	228.7	237.2	239.9	254.3	3.96%	5.09%	5.02%	2.97%	9.86%	0.95%
95.00%	221.2	217.5	221.0	218.6	233.6	246.6	3.67%	4.10%	3.57%	2.31%	6.27%	0.77%
90.00%	205.5	201.7	206.1	205.5	214.1	225.6	3.19%	2.04%	2.76%	1.79%	3.64%	0.69%
80.00%	192.4	185.6	173.8	190.9	161.9	151.4	2.49%	0.84%	1.97%	1.30%	2.19%	0.49%
75.00%	180.4	180.0	162.7	178.0	155.8	134.9	2.14%	0.63%	1.66%	1.05%	1.86%	0.33%
50.00%	155.0	157.8	127.5	154.6	119.4	106.5	1.15%	0.19%	0.76%	0.62%	1.01%	0.07%
Days with Perceptible Reduced Visual Range (%)												
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%	2.22%	3.33%	1.11%	6.67%	0.00%
Note: Days with impaired visibility based on Bext greater than 65.2 (1/Mm). Days with perceptible reduced visual range based on a change in Bext greater than 5 percent												

4/18/00, 2:55 PM

los_bext.xls, Oil Tables

The data in Table 12 through Table 16 suggest the influence of SE2 on visibility in the Lower Fraser Valley depends on the background aerosol concentration, season, LOS, and whether SE2 is oil-fired. Due to this complexity and the number of variables involved, it is difficult to generalize the results of the analysis. However, MFG believes the results of the analysis can be used to conclude:

- When SE2 is gas-fired, visual ranges and changes to extinction are small using the criteria for visibility impairment and perceptible change outlined above. The season most affected in the simulations is the fall. This is due to generally low background aerosol concentrations and winds that transport SE2 emissions into the Lower Fraser Valley. Winter background aerosol concentrations are also low, but the SE2 plume is transported less often into the Lower Fraser Valley.
- The potential highest impacts occur under the oil-fired scenario. Days with perceptible changes in haze are greater than 10 percent for the winter season for LOS 1, LOS 2, LOS 3 and LOS 5 under both median and good background visual conditions. LOS 4 and LOS 6 are less affected because the SE2 plume does not often cross these vistas during the winter.

As discussed on page 27, the likelihood that winds would carry emissions northward seems to decrease as temperature decreases. On the coldest days of winter when oil firing is most likely, there is almost always a net southward air movement and S2GF emissions would not affect Canada.

Although not explicitly cited in the comments, we understand that the potential for seeing the gas turbine plume is also a concern. MFG contacted a number of combined cycle plant operators who unanimously affirmed that there is no visible plume (except from condensed water vapor with high humidity) from those plants with NOx emissions less than 10 ppm. One operator familiar with gas and oil-fired plants asserted that the plume was not visible with either fuel.

The primary reason for the clean plume is related to the high amount of excess air with combustion turbines. Fossil fuel-fired boiler operators try to minimize excess air to improve efficiency, and typically operate at less than five percent excess oxygen. Operating on a completely different principle (as an air compressor generating thrust), combustion turbines routinely operate at excess oxygen rates of approximately 15 percent. The greater availability of oxygen supports more complete combustion of carbon and reduces the potential for a visible plume. Consequently, SE2 is confident that the plume itself will not be perceptible in Canada.

Attachment B

1996 Air Quality Monitoring Report,
PM10 Abbotsford

STATION T28

MONTH	#OF	% DATA		MEAN	REVIEW OF 1 HR AVERAGES						REVIEW OF 24HR AVERAGES					
	VALID	RECOVERY		HOURLY	#OF	PERCENTILES				#OF	PERCENTILES					
	DAYS	1HR	24HR	CONC	AVG	MAX	MIN	95	98	99	AVG	MAX	MIN	95	98	99
JAN	31	99	100	13	734	61	0	32	41	44	744	32	4	25	30	31
FEB	29	99	100	19	691	156	0	55	76	88	696	65	5	45	53	61
MAR	31	99	100	13	733	94	0	29	42	57	744	31	5	26	29	30
APR	30	98	100	10	706	75	0	20	24	28	720	21	4	14	19	20
MAY	17	57	56	12*	426	45	0	25	31	37	420	24	5	17	19	21
JUN	30	100	100	16	719	94	0	32	47	63	720	28	7	24	25	26
JUL	31	100	100	23	744	342	1	42	55	71	744	73	8	34	70	72
AUG	0	1	2	24*	11	43	9	43	43	43	17	25	22	25	25	25
SEP	17	60	56	19*	431	200	1	39	53	124	404	55	5	47	53	54
OCT	31	99	100	16	739	89	0	38	50	63	744	30	5	26	27	28
NOV	29	97	96	14	701	155	0	35	44	61	690	40	5	31	37	39
DEC	26	88	88	11	652	231	0	29	41	71	654	41	3	25	39	41
PERIOD																
SUM	302	83	83	15	7287	342	0	36	49	62	7297	73	3	30	38	47

Lower Fraser Valley Ambient Air Quality Report 1998



**Greater
Vancouver
Regional
District**

**Fraser
Valley
Regional
District**

Inhalable Particulate

9.1 Characteristics

The term 'PM₁₀' has been given to atmospheric particulates with a diameter of 10 micrometers (µm) or less (inhalable particulate). Because of their small size, these particles can be inhaled and deposited in the thoracic region of the lungs.

Exposure to PM₁₀ can chronically and acutely affect human health, particularly the pulmonary function. PM₁₀ can aggravate existing pulmonary and cardiovascular disease, affect mucociliary clearance and increase mortality. These effects are enhanced if high PM₁₀ levels are associated with higher levels of other pollutants, such as SO₂.

High PM₁₀ levels can also increase corrosion and soiling of materials, and may damage vegetation. The smaller particles can also have a major impact on visibility.

9.2 Sources

PM₁₀ is emitted from a variety of industrial, mobile and area sources, as a portion of total particulate emissions. A major urban source is road dust, which results from particles emitted from vehicles and other sources, as well as the natural deposition of sand and soil. In rural areas and drier environments, natural sources such as wind-blown soil, forest fires, ocean spray and volcanic activity may dominate.

9.3 GVRD Objectives

Desirable /Acceptable

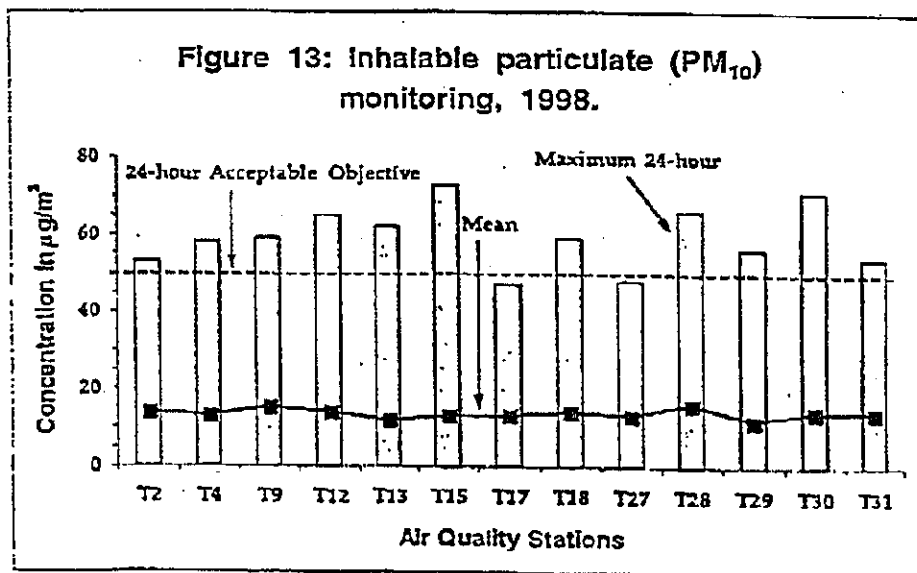
—/50 µg/m³ (24-hour)

—/30 µg/m³ (1-year)

9.4 Monitoring Results - Figures 13 and 14

Mean PM₁₀ readings in the LFV were between 10-20 µg/m³ at most sites during 1998. Minimum 24-hour values were consistently in the 3-4 µg/m³ range with maximum 24-hour values generally in the 50-60 µg/m³ range.

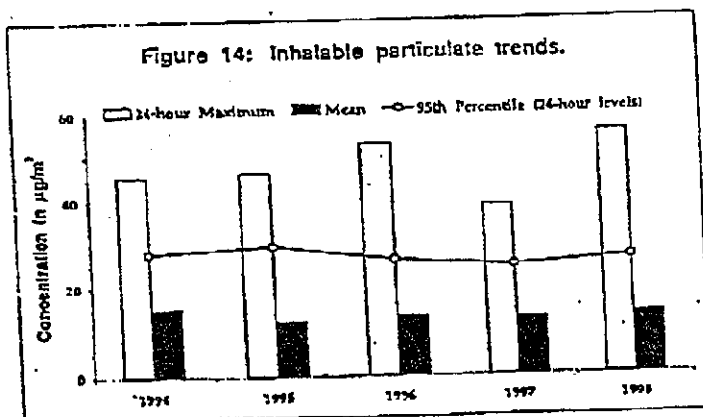
A significant number of exceedances of the 24-hour objective occurred during an unusually hot stagnant period at the end of April and beginning of May. The episode was dominated by an intensive high pressure system over the Pacific Northwest characterized by very hot temperatures, calm wind conditions and an intense temperature inversion.



These conditions brought on elevated inhalable particulate levels across the entire LFV. Other exceedances of the inhalable particulate objective were infrequent and were generally associated with short term local influences. Mean inhalable particulate levels continue to be highly influenced by meteorological conditions and tend to be slightly elevated during the drier, warmer summer and early fall periods and lower during the cooler, wetter portions of the year.

Figure 14 illustrates trends in inhalable particulate measurements in the region since monitoring started in 1994. Based upon the limited data collected to-date, no apparent trend in inhalable particulate measurements appears to have yet developed, with values remaining consistent throughout the 5-year period. Variations in the maximum 24-hour values are generally associated with short term episodes brought on by very specific meteorological conditions. In 1994, 1995 and 1996, these conditions were cold, very windy conditions which created dust storms localized in the eastern LFV. During 1998, the conditions were more regional in nature and were brought on by unseasonably hot, dry, stagnant conditions over a four day period at the end of April.

Exposure to PM₁₀
can chronically
and acutely affect
human health,
particularly the
pulmonary
function.



Maximum PM10 Event (July 1996) Concentration vs. Windspeed

Date	Hour	T28 PM10 1hr	T28 PM10 24hr	YXX WS (km/hr) hr	YVR WS (km/hr) hr
24-Jul-96	7	39	25.7	0	15
	8	38	26.5	6	20
	9	30	27.0	0	26
	10	46	27.9	7	26
	11	60	29.0	11	26
	12	45	29.5	11	26
	13	35	29.4	15	26
	14	33	29.2	15	22
	15	32	29.1	19	15
	16	19	28.8	7	17
	17	19	28.7	9	11
	18	32	29.0	15	9
	19	10	28.5	2	6
	20	18	28.6	11	4
	21	10	28.4	7	0
	22	26	28.9	4	4
	23	342	42.4	0	9
	24	148	47.7	4	7
25-Jul-96	1	340	60.7	0	0
	2	97	63.7	7	0
	3	173	70.0	0	11
	4	71	71.6	0	7
	5	52	72.8	0	7
	6	36	73.0	0	9

PERMIT	LAT	LONGI	CLIENT	SIC	SIC_DESCRIPTION	Emissions in tonnes/year							PM25
						CO	NOX	SOX	VOC	PART	PM10		
3748	49.02083	-122.4388	Columbia Bitulithic Limited	36990	Other Petroleum & Coal Produ	5.7	5.7	48.8	4.1	28.1	4.0	0.3	
7768	49.12904	-122.3557	Northside Cedar Products I	25110	Shingle and Shake Industry					14.5	5.8	2.9	
8264	49.00253	-122.2616	Almsworth Lumber Co. Ltd.	25120	Sawmill & Planing Mill Product					47.0	18.8	9.4	
8515	49.04784	-122.3157	Abbotsford Auto Body Ltd.	63520	Paint and Body Repair Shops	0.1	0.6	0.0	1.0	6.7	4.6	2.0	
8915	49.01259	-122.4529	Peter Kiewit Sons Co. Ltd.	36990	Other Petroleum & Coal Produ	1.6	3.9	5.6	1.1	3.4	2.7	2.2	
10557	49.0296	-122.2749	Saran Cedar Ltd.	25120	Sawmill & Planing Mill Product					10.9	4.4	2.2	
10651	49.02061	-122.275	North American Building Pr	25120	Sawmill & Planing Mill Product					12.4	5.0	2.5	
10656	49.01161	-122.2752	Westree Custom Cedar Pr	25120	Sawmill & Planing Mill Product					25.3	10.1	5.1	
10817	49.01253	-122.4393	Grandview Blacktop Ltd.	36990	Other Petroleum & Coal Produ	4.9	5.0	37.5	3.5	19.8	2.8	0.2	
11352	49.05737	-122.4114	Duraglas Products Ltd.	26110	Wooden Household Furniture I					16.9	9.7	6.9	
12657	49.05737	-122.4114	Dynamic Windows & Doors	25430	Wooden Door and Window Ind				0.2	10.6	5.0	3.1	
Totals =						12.3	15.1	91.8	9.9	195.5	72.8	36.7	

Attachment E

Eligible Sources for PSD Class II
Increment Analysis within 20 km of Sumas2

11/10/2010 10:00:00 AM

(note points 12 and 13)

SUMAS ENERGY 2, INC.

335 Parkplace • Suite 110 • Kirkland, Washington 98033 • PHONE: (425) 889-1000 • FAX (425) 803-6902

January 7, 2000

Mr. Hu Wallis
Manager, Air Quality Assessment
Ministry of the Environment, Lands and Parks
P.O. Box 9341, Stn Provincial Government
Victoria BC V8W 9M1

Subject: Sumas 2 Generating Facility (S2GF)

Dear Mr. Wallis:

Thank you for your letter of December 14 which provided a summary list of air quality concerns and issues raised by the Ministry and by the Lower Fraser Valley Air Quality Coordinating Council. Input from the Ministry and Council has been very helpful, and we are particularly thankful for your assistance on the regional air quality studies (the CALPUFF/CALMET studies and your photochemical modeling). We want to develop a plant that is recognized by U.S. and Canadian air quality agencies as having incorporated state-of-the-art control technologies to minimize impacts on both sides of the border.

With assistance from our air quality consultants at MFG, I have prepared this letter to let you know how we have responded to your concerns and to reiterate our interest in working with the Ministry and Council in successfully resolving the issues you have addressed. To provide additional detail on our assessment, I am enclosing a copy of Section 6.1 of our Application to the Energy Facility Site Evaluation Council (EFSEC). This Section, prepared pursuant to Washington Administrative Code 463-42-385, describes the technical air quality analyses conducted to date. I think you will find that the results of our analyses are very encouraging.

First I'd like to highlight several key changes in our proposal since we last visited with the Council. We initially proposed constructing either a Westinghouse turbine-based system capable of generating 720 MW or a GE turbine-based system capable of generating 800 MW. The Westinghouse turbines would have employed Selective Catalytic Reduction (SCR) capable of reducing emissions of oxides of nitrogen (NOx) to 4.5 ppm. The GE turbines would have relied on Advanced Dry Low-NOx technology to reduce NOx emissions to 9 ppm. Both of these options have been determined to represent Best Available Control Technology (BACT) in recent permit actions by EFSEC.

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In part due to concerns raised by the Council and the Fraser Valley Regional District, we have decreased the generating capacity of our facility from 720 MW to a nominal 660 MW. This change in itself would have reduced all pollutant emissions compared with the initial proposal. However, we have also decided to drop the GE option (9 ppm) and to enhance NOx control from the Westinghouse option to achieve 3 ppm. These decisions reflect our sincere interest in minimizing environmental impacts. When we developed Sumas Energy 1 in 1991, we set a new standard for BACT by being the first private power producer in the Northwest to propose a NOx limit of 6 ppm. With the development of Sumas 2 Generating Facility (S2GF), we will again set a new standard for BACT by proposing a NOx limit of 3 ppm.

Two other design changes are likely to be of interest to the Ministry, Council, and the District. To reduce our requirements for cooling water, we are proposing the use of an air-cooled condenser to supplement our cooling tower. Although expensive, we estimate that our water consumption will be only 25 percent of the quantity initially anticipated. This change also means we are no longer seeking a source of water in Canada. Additional benefits from the use of the air-cooled condenser include a reduction in the frequency of occurrence and size of our cooling tower plume, a reduction in the quantity of cooling tower drift released, a reduction in the amount of wastewater generated by the cooling tower, and a virtual elimination of the potential for fogging and icing of Washington State Highway 9.

We have also incorporated the capacity to burn low sulfur (0.05% sulfur, by weight) distillate oil. This change also required additional capital investment, but we made the change in response to a concern raised in a letter from B.C. Hydro. With the capacity to burn oil, S2GF can free up natural gas pipeline capacity to ensure that commercial and residential gas consumers are not deprived during periods of particularly cold weather. S2GF has committed to burning oil no more than 15 days per year. Note, however, that natural gas shortages have historically been infrequent and we do not anticipate operating on oil often.

In the following pages, we repeat each of your comments in italics and follow the comment with a brief summary of how we have responded.

1. *Condition of Airshed: The proposed facility will add pollutants into an airshed already experiencing episodes of elevated ozone and PM as well as poor visibility.*

All combustion sources generate air pollutants, and we acknowledge that S2GF will incrementally increase regional emissions. As noted above, however, S2GF has reduced the scale of its project and has substantially decreased NOx emissions. Because NOx is a precursor to ozone formation, we believe we have also substantially reduced our potential effect on ozone episodes.

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As you are aware, Environment Canada is currently reviewing the results of their regional photochemical modeling that includes emissions from S2GF. While the results have not yet been fully assessed, it is our expectation (based on the small portion of regional emissions we represent) that the S2GF will not have significant adverse effects on regional ozone problems.

Similarly, we acknowledge that primary and secondary emissions attributable to the S2GF will incrementally increase regional haze. However, our preferred use of natural gas in the proposed combined cycle generating facility is the most energy efficient and least-polluting means of producing electricity that is currently available for fossil fuel based plants. In the scheme of things, our contribution to regional haze is relatively small. Furthermore, merchant plants such as the S2GF have the potential to displace older, less efficient electrical generating stations and may ultimately reduce air emissions attributable to regional electric power generation.

2. *Existing Air Quality Management Efforts in the Lower Fraser Valley: The project needs to consider the extensive efforts of various agencies have made to improve the air quality in the Lower Fraser Valley. Refer to the Air Quality Management Plans for both the GVRD (Dec 1994) and FVRD (Feb 1998). In addition, note the efforts of the Canadian Federal and BC governments in the implementation of a comprehensive set of regulations for motor vehicle fuels and emission.*

Sumas Energy 2 applauds the efforts of various Canadian and U.S. agencies to improve air quality. We also appreciate your comments and technical evaluation of our proposal. We concur with the concept that improved air quality requires cooperation from everyone. We believe our voluntary commitment to proposing emission limits well below those recently determined to be BACT is evidence that we intend to be part of the solution.

3. *Compliance with BC Ambient Objectives: The air quality impacts associated with the project need to be assessed in relation to BC ambient air quality objectives for NO₂, CO, SO₂, PM₁₀, and O₃.*

The air quality analysis in our EFSEC Application for Site Certification (Application) assessed the ambient air quality implications of the S2GF. Our analysis estimated maximum short-term concentrations by conservatively summing predictions based on the worst meteorological events in five winters, oil-fired turbine emissions from S2GF, and the highest background concentrations from Abbotsford during 1996 to 1998. Even with this approach, we found that total air pollutant concentrations would be less than

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the most stringent Canadian Air Quality Objectives for SO₂, carbon monoxide (CO), and nitrogen dioxide (NO₂).

Monitoring data collected in Abbotsford indicate the Greater Vancouver Regional District (GVRD) interim 24-hour objective for PM₁₀ is exceeded from zero to four days per year. Higher PM₁₀ observations at Abbotsford have historically been associated with high wind events and windblown dust from agricultural areas and exposed soils in the eastern portion of the Lower Fraser Valley. Although such events can occur during the winter, those meteorological conditions are different than the conditions producing the highest S2GF concentrations. Maximum potential concentrations from S2GF occur while burning oil with light winds and stable conditions. Consequently, MFG believes it is unlikely that the S2GF will contribute to or cause PM₁₀ concentrations above the interim GVRD 24-hour Maximum Acceptable Objective.

4. *Cooling Tower Emissions: Water vapor (and associated nitrates) emissions on plume chemistry and the formation of nitrate aerosols should be included in assessing local and regional PM and visibility impacts.*

The proposed S2GF configuration includes a wet/dry cooling system based on an air-cooled condenser and a cooling tower. The cooling tower would supplement the air-cooled condenser, providing up to 46 % of the thermal duty during warmer months. A small portion of the nitrate contained in the local water supply would be emitted from the cooling tower as cooling tower drift. Our cooling tower design calls for a maximum circulation rate of 51,250 gallons per minute with a drift loss rate of 0.0005 %. At this rate, the maximum nitrate emission rate would be about 0.002 lb/hr based on a nitrate concentration of 17 mg/l in the water supply. We believe your technical staff will affirm that these emissions are negligible.

5. *Ammonia Emissions: The use of SCR control technology with ammonia injection will result in direct ammonia impacts as well as ammonia contributions to secondary PM formation. It is important to consider these impacts given that ammonia is a major concern in the eastern LFV (due to agricultural activities) and current understanding of their involvement in photochemical processes.*

Ammonia slip will be less than 10 ppmvd (15% O₂) for all operating scenarios. Based on this proposed permit limit, an assumed operating scenario of 350 days of gas firing (with duct burners), and 15 days of oil firing, MFG has estimated annual ammonia emissions of 276 U.S. TPY from our facility. The modeling analysis conducted for our plant indicates these emissions

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would result in maximum 24-hour and annual ammonia concentrations of $6 \mu\text{g}/\text{m}^3$ and $0.6 \mu\text{g}/\text{m}^3$, respectively. The maximum 24-hour predicted ammonia concentration is much less than the $100 \mu\text{g}/\text{m}^3$ screening criterion Washington applies to protect public health.

In 1996, Environment Canada conducted a monitoring program in which ammonia concentrations were measured at Abbotsford. The measured annual ammonia concentration was $16.4 \mu\text{g}/\text{m}^3$ during this period. The maximum predicted worst-case annual concentration attributable to S2GF is $0.6 \mu\text{g}/\text{m}^3$ or about 4% of the monitored background value. This indicates to us that our ammonia emissions would not significantly contribute to annual ammonia concentrations in the Lower Fraser Valley.

Environment Canada also collected data on other airborne nitrogen compounds during 1996, and estimated the annual nitrogen deposition flux in Abbotsford to be $8.6 \text{ kg}/\text{ha}/\text{yr}$. As you are aware, we have conducted an extensive regional modeling analysis using the CALMET/CALPUFF modeling system. That analysis estimated the maximum annual nitrogen deposition flux attributable to our facility to be $0.05 \text{ kg}/\text{ha}/\text{yr}$ - a small fraction of existing nitrogen deposition in the Lower Fraser Valley.

Existing ammonia concentrations in the Lower Fraser Valley contribute to secondary aerosol formation under certain meteorological conditions. Due to the large background concentrations of ammonia, MFG believes aerosol formation is not limited by available ammonia in the Lower Fraser Valley and the small additional amount of ammonia emitted from the S2GF should not promote further aerosol formation. The CALPUFF modeling conducted by MFG indicates aerosol formation is not a strong function of ammonia once the ammonia concentration reaches the level of existing concentrations at Abbotsford. Under these conditions, secondary aerosol formation is a stronger function of sulfate concentration, the nitrogen chemistry, and relative humidity.

6. *O₃ and PM (Urban Smog) Formation: The increase in PM and O₃ due to Sumas 2 emissions is of concern due to direct emissions of PM, the precursor emissions (NO_x, SO₂, VOC, NH₄, H₂O, nitrates in water vapor) and the existing levels of these pollutants in the region. These are regional issues, and the assessed air quality impacts of the project should include the areas in BC that will be affected.*

We believe this concern is addressed by our response to comments 1. and 3. Please let us know if this is not the case.

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7. *Emissions Technology – BACT: Existing facilities in the region are generally subject to BACT, particularly significant sources, of which Burrard Thermal is one example.*

S2GF is also subject to BACT. As noted above, we have chosen to go beyond BACT - in part due to concerns raised in our visits to the District and the Council.

The following table compares potential emissions associated with S2GF with those from Burrard Thermal. Emissions from Burrard Thermal assume that all boilers have been retrofitted with SCR, that they operate at 85% of capacity, and that our plant operates at 100% of capacity. This table indicates potential NOx, SO2, and particulate matter emissions from S2GF are substantially lower than those from Burrard Thermal, and that the quantity of emissions per unit of energy is much lower with the S2GF.

Comparison of Emissions: Burrard Thermal and S2GF

NOx	Burrard Thermal	S2GF	Ratio S2GF/Burrard
NOx			
U.S. tons per year	788	236	30%
Lb/MW-hr	0.23	0.08	35%
SO2			
U.S. tons per year	225	45	20%
Lb/MW-hr	0.07	0.016	24%
PM (filterable)			
U.S. tons per year	225	60	27%
Lb/MW-hr	0.07	0.02	32%
Burrard annual emissions limited to 85% of PTE, per permit condition; calcs assume all boilers have SCR			
SE2 emissions based on SCR providing 3.0 ppm Nox operating 8,760 hrs/yr, including 15 days on oil			
Burrard combined stack gas flow (m ³ /min): 45,600			
Assumes Burrard generates 912.5 MW			
Assume S2GF generates 660 MW			

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8. *The EIS should consider including emissions modeling for the project which takes the new plant design into account.*

S2GF's EFSEC Application and the Draft Environmental Impact Statement take the new plant design and emissions into account.

9. *Visibility: Ambient PM increase due to this source (from both the stacks and cooling towers) will degrade visibility in the region. The potential impact on visibility in areas of BC should be considered.*

Visible plumes from the cooling tower will be short and will not obscure visual resources in the Lower Fraser Valley. During daytime hours when the visibility is not obscured by local weather, average condensed plume lengths would be less than 50 m. It is highly unlikely that a visible cooling tower plume would cross the border into Canada.

The effects on regional haze due to PM₁₀ directly emitted by the S2GF, and secondary aerosols formed during transport, were assessed using the CALPUFF modeling system. The regional haze modeling analysis focused on potential visibility degradation in wilderness areas and national parks located in Washington State. Model-predicted extinction coefficients were compared to background extinction coefficients calculated from aerosol data on days with good visibility. The techniques in this analysis assume concentrations at specific receptors are representative of visual path-lengths that might be 100 km in length. The predictions from the CALPUFF modeling analysis suggest the S2GF will not significantly degrade visibility in these areas.

The CALPUFF model region includes the Lower Fraser Valley. Predictions of sulfate, nitrate, and PM₁₀ were also obtained for receptors in British Columbia. The higher aerosol concentrations are predicted on Sumas Mountain, with much lower concentrations at lower elevations. In these instances the aerosol plume from the S2GF is comprised primarily of PM₁₀ directly emitted and a small amount of nitrate formed during transport. The aerosol plume is also predicted to contain sulfate aerosols when the S2GF is fired by oil. The maximum predicted nitrate and sulfate concentrations are much less than observed in Abbotsford by Environment Canada during their 1996 study. The predicted change in local extinction coefficients caused by aerosols from the S2GF in the CALPUFF analysis suggests some reduction in local visibility may be possible depending on the geometry between the observer and the visual target, whether the S2GF is oil-fired, and background visual conditions.

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Because there are so many variables in an assessment of visibility, it is difficult or impossible to fully characterize the impact of a single source. Our effect on visibility is likely to be proportional to our emissions compared with regional emissions.

10. *Diesel Fuel: The air quality impacts of burning distillate fuel oil at the proposed facility should be taken into account due to elevated SOx, PM, VOC emissions relative to that associated with natural gas. This could be assessed using worst-case assumptions, or on the basis of a year round simulation – depending on how distillate oil burning is limited. Earlier correspondence identified concerns regarding air quality impacts associated with fugitive emissions from diesel fuel storage. However, recent discussions between GVRD and Sumas 2 staff have eliminated this as a concern.*

S2GF's EFSEC Application and the Draft Environmental Impact Statement address the air quality impacts of burning distillate oil. The short-term emission rates evaluated in our modeling are based on burning oil even though oil burning is expected to be infrequent. Annual air pollutant concentrations are based on the assumption that oil burning will occur a full 15 days per year (the requested permit limit), and that the plant will burn natural gas every other hour of the year. Given that natural gas shortages are infrequent and that 100 percent operating time is virtually impossible, we believe we have evaluated a very conservative operating scenario.

11. *Continuous Emissions Monitoring (CEM): A CEM with real time data availability is installed at the Burrard Thermal power plant and other regionally significant sources. Continuous in-stack source monitoring should be considered.*

S2GF proposes to install and operate continuous emission monitors to measure concentrations of oxides of nitrogen, carbon monoxide, and oxygen in each exhaust stack.

12. *Ambient Air Quality Monitoring: It would be prudent to ensure that there is adequate ambient air quality monitoring as there is no monitoring information in the area of the proposed Sumas 2 facility. It is noted that such monitoring is a permit requirement funded by the proponent in a number of BC situations, including Burrard Thermal.*

We will fund an air quality monitoring station since it should assist in efforts to improve regional air quality. Because our focus is on electrical power generation, we assume that operation of such a station would be the responsibility of staff from the GVRD, the Ministry, or the Northwest Air Pollution Authority. We would like to meet with Canadian and U.S. regulatory agency staff to discuss the scope of the monitoring program.

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13. *Curtailment Provisions: Noting that Burrard Thermal is subject to curtailment under conditions of poor air quality, it is suggested that curtailment provisions be considered for the plant.*

Burrard Thermal is an older plant with higher emissions and a greater potential for contributing to ozone episodes. Nonetheless, using Burrard Thermal emissions as a reference, we are prepared to consider some reasonable curtailment arrangements provided that those arrangements will allow us to continue to honor our contractual commitments to supply power to our customers.

14. *Greenhouse Gas Mitigation Plan: A greenhouse gas mitigation plan should be submitted as part of the EIS.*

At present, neither Washington nor British Columbia has established laws or regulations that require a greenhouse gas (GHG) mitigation plan. Moreover, the S2GF's high efficiency low emission design makes it a mitigation project itself to the extent that it displaces older, less efficient power plants. Nonetheless, we have examined the material you provided, including examples of GHG mitigation implemented by two Canadian industrial sources. We have also examined a program established by the State of Oregon.

In the spirit of cooperation, SE2 has prepared a Greenhouse Gas Mitigation Plan which will be submitted to EFSEC. In short, SE2 proposes to make a substantial investment in GHG research, in offset plans and/or management programs. SE2's strategic plan sets forth voluntary GHG mitigation goals, as well as measures that can be taken to achieve them. It identifies a menu of potential GHG offset and management opportunities.

I have referred to our air quality analyses in a number of my responses to concerns expressed in your letter. In the interest of maintaining a direct dialog, I am enclosing with this letter a copy of Section 6.1 of the EFSEC Application. Although other sections of the application address related air quality issues, this Section is the heart of our air quality analysis. We encourage you and your staff to review this Section, and to call me or our air quality consultants at MFG, Inc. if you have any questions. Our consultants, Eric Hansen and Ken Richmond, may be reached at 425.921.4000.

I also encourage you to review the related Sections in the EFSEC Application, which should arrive within about a week. Appendices to the Application provide additional information

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on our cooling tower analysis, the CALPUFF modeling protocol, the BACT analysis, and the Greenhouse Gas Mitigation Plan.

Thank you once again for your continued interest and technical support in our project. We look forward to an opportunity to meet with you to discuss our findings, and those of your photochemical modeling effort.

Sincerely,



David N. Eaden, Vice President
Engineering & Construction
Sumas Energy 2, Inc.

DNE:bb

cc: Don A. Fast, Ministry of Environment, Lands and Parks
Steven Sakiyama, Ministry of Environment, Lands and Parks
Darrell Jones, Sumas Energy 2, Inc.
Bruce Thompson, Sumas Energy 2, Inc.
Eric Hansen, MFG, Inc.
Katy Chaney, Dames & Moore

Enclosure: Chapter 6.1 of the EFSEC Application for Site Certification

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